J Korean Neurosurg Soc 37 : 300-302, 2005

Case Report

Surgical Resuscitation of a Patient with Cerebral Herniation Secondary to Massive Hemorrhage in the Basal Ganglia : Ultrasound-monitored Aspiration

Youn - Ho Jung, M.D., Jae Chan Park, M.D., In-Suk Hamm, M.D.

Department of Neurosurgery, School of Medicine, Kyungpook National University, Daegu, Korea

The authors report a case of hyperacute, massive hemorrhage in the left basal ganglia with severe midline shift that was treated successfully by the ultrasound-monitored free hand aspiration technique. Every effort was made to shorten time until removal of considerable amount of the hematoma and minimize duration of cerebral herniation, avoiding additional irreversible neurological deficit. A burr hole aspiration technique was preferred to standard craniotomy procedure, and any time-consuming procedures such as stereotactic frame application were abandoned. A burr hole was localized on the basis of computed tomography images simply and quickly with a ruler, and safety of the aspiration procedure was augmented by real-time ultrasound monitoring. Such minimally invasive technique relieved cerebral herniation successfully while avoiding time consumption and the morbidity of major craniotomy procedure. Early resuscitation of the patient with cerebral herniation in this case resulted in excellent recovery of the patient's neurological deficit. The patient's mentality started to improve rapidly and was clear six months after the surgery.

KEY WORDS : Aspiration · Cerebral herniation · Free hand technique · Intracerebral hemorrhage · Ultrasound-monitored.

Introduction

Optimal treatment of hypertensive intracerebral hemorrhage(ICH) is still controversial. However, cerebral herniation secondary to hyperacute massive ICH warrants prompt surgical removal of the hematoma in order to relieve the cerebral herniation as soon as possible[11]. Although a craniotomy is accepted as a standard management for massive ICH[1], we chose a burr hole aspiration in order to reduce the time required to relieve the cerebral herniation and minimize surgical morbidity.

Any time-consuming procedures such as stereotactic frame application were abandoned, and safety of the aspiration procedure was augmented by monitoring the procedure with real-time ultrasound. Such minimally invasive technique may relieve cerebral herniation promptly while avoiding the morbidity of major craniotomy procedure.

• Received : July 26, 2004 • Accepted : August 16, 2004
• Address for reprints : Jae Chan Park, M.D., Department of Neurosurgery, School of Medicine, Kyungpook National University, 50 Samduk 2-ga, Jung-gu, Daegu 700-721, Korea
Tel : 053)420-5647, Fax : 053)423-0504
E-mail : jparkmd@hotmail.com jparkmd@wmail.knu.ac.kr

Case Report

History

A 73-year-old woman developed abrupt mental deterioration and a right-sided hemiplegia thirty minutes prior to admission. The medical history was unremarkable except for untreated arterial hypertension.

Examination

Upon arrival to the emergency department, she was nonverbal and semicomatose without localizing noxious stimuli (GCS 6). She had a rightsided hemiplegia and anisocoria. A computed tomography(CT) scan of the brain revealed a massive irregular

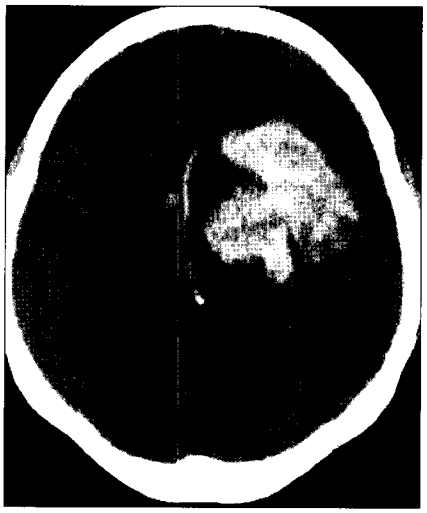

Fig. 1. Axial computed tomography scan revealing a massive intracerebral hemorrhage in the left putaminal area with midline shift of the septum pellucidum greater than 12mm.

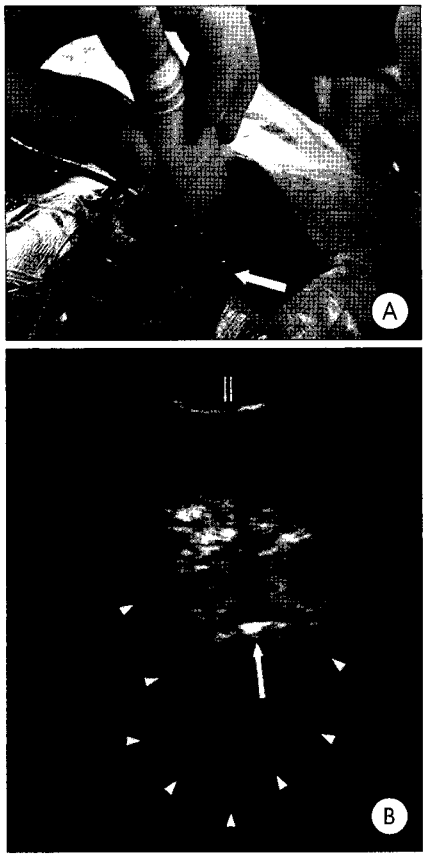

Fig. 2. A : Intraoperative photograph showing an ultrasound probe applied through a burr hole and a silicone catheter(arrow) connected to a syringe. B : Intraoperative ultrasound demonstrating real-time image of hematoma aspiration. A catheter as a dense echogenic dot, well-defined margins of a hyperechogenic hematoma (arrowheads), and surrounding hypoechogenic brain tissue are demonstrated. The dura mater (double arrows) is shown as a hyperechgenic line.

ICH occupying left putaminal area and internal capsule with midline shift of the septum pellucidum greater than 12mm (Fig. 1). The hematoma measured about 80mL.

Operation

Mannitol was given in the emergency department, and the patient was taken to the operating room immediately. Finally, a burr hole aspiration was performed about an hour after the hemorrhagic ictus. Under general anesthesia, a burr hole site was localized on the left temporal scalp on the basis of CT images without the aid of stereotactic systems. A line was drawn on the scalp 5cm superior and parallel to the orbitomeatal line. A point 6.5cm posterior to the forehead was marked on the line with an L-shaped ruler. A burr hole was made on the point that centered the irregular hematoma.

Ultrasound guidance with the 7.5-MHz transducer through the burr hole allowed exact placement of a silicone catheter deep in the anterior portion of the hematoma. The catheter was remarkable as a dense echogenic dot, and its tip was traced by the ultrasound. The hematoma was gently aspirated manually with a syringe under ultrasound monitoring that demonstrated real-time images of shrinking hematoma around the catheter tip (Fig. 2). After removing hyperechogenic hematoma in depth, the catheter was withdrawn to a superficial part and aspiration under ultrasound monitoring was continued. Then, the catheter was re-introduced into the posterior portion of the bilobed hematoma under the ultrasound guidance, and ultrasound-monitored aspiration was repeated again. After removing substantial amount (more than 50mL) of the hematoma to relieve cerebral herniation, the catheter was left in place for urokinase irrigation of the remnant.

Fig. 3. Axial computed tomography scan on the third postoperative day showing clearance of intracerebral hemorrhage after urokinase irrigation.

Postoperative course and examination

On the first postoperative day, the patient opened her eyes to request, and her pupils were isocoric and reactive to light. The ICH was reduced to a small amount, less than 30mL, and the midline shift was much improved on a CT scan of the brain. On the third postoperative day after urokinase irrigation, the he-matoma was cle-ared (Fig. 3).

Six months after the surgery, her mentality was clear with moderate motor dysphasia although she was still hemiplegic on the right side.

Discussion

Prompt relieving cerebral herniation secondary to massive ICH is very important to improve the clinical outcome. Time window from cerebral herniation to irreversible neurological deficit is uncertain, but earlier relief of cerebral herniation seems mandatory to get better result. So, we have to do our best to shorten the duration of cerebral herniation. Time-consuming procedures before removing considerable amount of hematomas such as craniotomy procedures, stereotactic frame application and repeated scanning with fiducials for neuronavigation should be abandoned. We preferred a burr hole aspiration technique to open craniotomy, and the burr hole site was localized on the basis of CT images simply and quickly with a ruler[10].

Hyperacute spontaneous ICH may be defined as spontaneous intracerebral heorrhage within three to six hours of symptom onset[2,4-6]. A prospective observational study of patients with ICH within 3hours of onset revealed hem-

orrhage enlargement between the baseline and 1-hour CT scans in 26% of the patients[2]. Moreover, a study of surgical hematoma evacuation using a standard craniotomy within 4 hours of symptom onset showed rebleeding occurrence in 40% of the operated patients[9]. However, such unstable characteristics of the hyperacute ICH does not warrant delayed evacuation of the hematoma in cases of massive hemorrhage causing cerebral herniation.

It is the first report to perform real-time monitoring by ultrasonography for safe and successful aspiration of hyperacute hematomas, although ultrasonography has been used widely in the neurosurgical field[3,7]. It seems that the critical time for rebleeding is the first few hours after symptom onset[9], so the hematomas need to be aspirated cautiously under ultrasound monitoring. The ultrasound monitoring demonstrates real-time images of the shrinking hematoma surrounding the catheter tip in addition to geographical illustrations of the hyperechogenic hematoma, the hypoechogenic brain tissue, and the densely echogenic catheter. Any rebleeding during aspiration could be recognized. Real-time ultrasound characteristics of the acute ICH was studied by Lillehei, et al[8] in the canine model. ICHs are initially hypoechogenic, becoming hyperechogenic between 16 and 23 seconds after hemorrhage.

Stereotactic system based upon preoperative images may provide erroneous guidance to the remnant hematoma after aspirating a large part of the irregular hematoma. In this situation, ultrasonogrhy may optimize reinsertion of the catheter into the residual part.

Conclusion

Hyperacute ICH with cerebral herniation warrants prompt surgical removal of the hematoma. Prompt aspiration of the massive deep-seated ICH under ultrasound-monitoring may resuscitate patients with cerebral herniation safely and successfully.

References

1. Ahn CS, Lee SK, Kim HS, Kong MH, Song KY, Kang DS : Surgical outcome of spontaneous intracerebral hemorrhage in less than stuporous mental status. **J Korean Neurosurg Soc 35** : 290-296, 2004
2. Brott T, Broderick J, Kothari R, Barsan W, Tomsick T, Sauberbeck L, et al : Early hemorrhage growth in patients with intracerebral hemorrhage. **Stroke 28** : 1-5, 1997
3. Cokluk C, Iyigun O, Senel A, Celik F, Rakunt C : The guidance of intraoperative ultrasonography in the surgical treatment of arteriovenous malformation. **Minim Invas Neurosurg 46** : 169-172, 2003
4. Fiebach JB, Schellinger PD, Gass A, Kucinski T, Siebler M, Villringer A, et al : Stroke magnetic resonance imaging is accurate in hyperacute intracerebral hemorrhage. **Stroke 35** : 502-507, 2004
5. Fujii Y, Tanaka R, Takeuchi S, Koike T, Minakawa T, Sasaki O : Hematoma enlargement in spontaneous intracerebral hemorrhage. **J Neurosurg 80** : 51-57, 1994
6. Gebel JM Jr, Jauch EC, Brott TG, Khoury J, Sauerbeck L, Salisbury S, et al : Natural history of perihematomal edema in patients with hyperacute spontaneous intracerebral hemorrhage. **Stroke 33** : 2631-2635, 2002
7. Hammoud MA, Ligon BL, Elsouki R : Use of intraoperative ultrasound for localizing tumors and determining the extent of resection: a comparative study with magnetic resonance imaging. **J Neurosurg 84** : 737-741, 1996
8. Lillehei KO, Chandler WF, Knake JE : Real time ultrasound characteristics of the acute intracerebral hemorrhage as studied in the canine model. **Neurosurgery 14** : 48-51, 1984
9. Morgenstern LB, Demchuk AM, Kim DH, Frankowski RF, Grotta JC : Rebleeding leads to poor outcome in ultra-early craniotomy for intracerebral hemorrhage. **Neurology 56** : 1294-1299, 2001
10. Penning L : CT localization of a convexity brain tumor on the scalp. **J Neurosurg 66** : 474-476, 1987
11. Rabinstein AA, Atkinson JL, Wijdicks EF : Emergency craniotomy in patients worsening due to expanded cerebral hematoma : To what purpose? **Neurology 58** : 1367-1372, 2002