 doi: 10.2176/jns-nmc.2022-0356

NMC Case Report Journal 10, 93-98, 2023

Two Cases of Chronic Subdural Hematoma with Spontaneous Intracranial Hypotention Treated with Hematoma Drainage Followed by Epidural Blood Patch Under Intracranial Pressure Monitoring

Toshitsugu TERAKADO,[1] Akibumi OMI,[2] Yuji MATSUMARU,[3] and Eiichi ISHIKAWA[3]

[1]*Department of Neurosurgery, Koyama Memorial Hospital, Kashima, Ibaraki, Japan*
[2]*Department of Anesthesiology, Koyama Memorial Hospital, Kashima, Ibaraki, Japan*
[3]*Department of Neurosurgery, Faculty of Medicine, University of Tsukuba, Tsukuba, Ibaraki, Japan*

Abstract

Both chronic subdural hematoma (CSDH) and spontaneous intracranial hypotension (SIH) cause headaches. However, the etiologies are different: SIH headache is caused by decreased intracranial pressure (ICP), whereas CSDH headache results from increased ICP. Moreover, CSDH is treated by hematoma drainage, while SIH is treated by epidural blood patch (EBP). Treatment for the cases of combined SIH and CSDH is not well-established. Herein, we report two cases wherein ICP was monitored and safely controlled by EBP after hematoma drainage. Case 1: A 55-year-old man with progressive consciousness disturbance was diagnosed with bilateral CSDH. He underwent bilateral hematoma drainage; however, the headache became apparent during standing. We diagnosed SIH by diffuse pachymeningeal enhancement on brain MRI and epidural contrast medium leakage on CT myelography. Due to the reenlargement of bilateral CSDH, we performed EBP after hematoma drainage and ICP monitor insertion. Finally, the headache and bilateral CSDH were resolved. Case 2: A 54-year-old man with persistent headache was diagnosed with bilateral CSDH. He underwent multiple hematoma drainage sessions. However, headache on standing persisted. We diagnosed SIH by diffuse pachymeningeal enhancement on brain MRI and epidural contrast medium leakage on CT myelography. Due to the reenlargement of the left CSDH, we performed EBP after left hematoma drainage and ICP monitor insertion. Finally, the headache and bilateral CSDH were resolved. EBP after hematoma drainage and ICP monitoring was useful for SIH with bilateral CSDH. By monitoring ICP before EBP, the ICP was safely controlled and CSDH was resolved.

Keywords: spontaneous intracranial hypotension, chronic subdural hematoma, epidural blood patch, intracranial pressure monitoring

Introduction

Chronic subdural hematoma (CSDH) due to increased intracranial pressure (ICP) usually results in headaches. Rarely, CSDH can result from decreased ICP due to spontaneous intracranial hypotension (SIH). The regular treatment for CSDH is hematoma drainage; however, in cases of SIH-associated CSDH, the hematoma drainage can suddenly decrease ICP and cause cerebral herniation.[1,2] An epidural blood patch (EBP), which is a typical treatment option for SIH resistant to conservative therapy,[3] is believed to stop cerebrospinal leakage. The use of an EBP rarely raises ICP rapidly and causes a disturbance in consciousness.[4] Herein, we present two patients with SIH-associated bilateral CSDH treated with EBP after hematoma drainage and ICP monitoring, enabling visualization and safe control of ICP. This approach is a novel treatment option for SIH with CSDH.

Received November 10, 2022; Accepted January 23, 2023

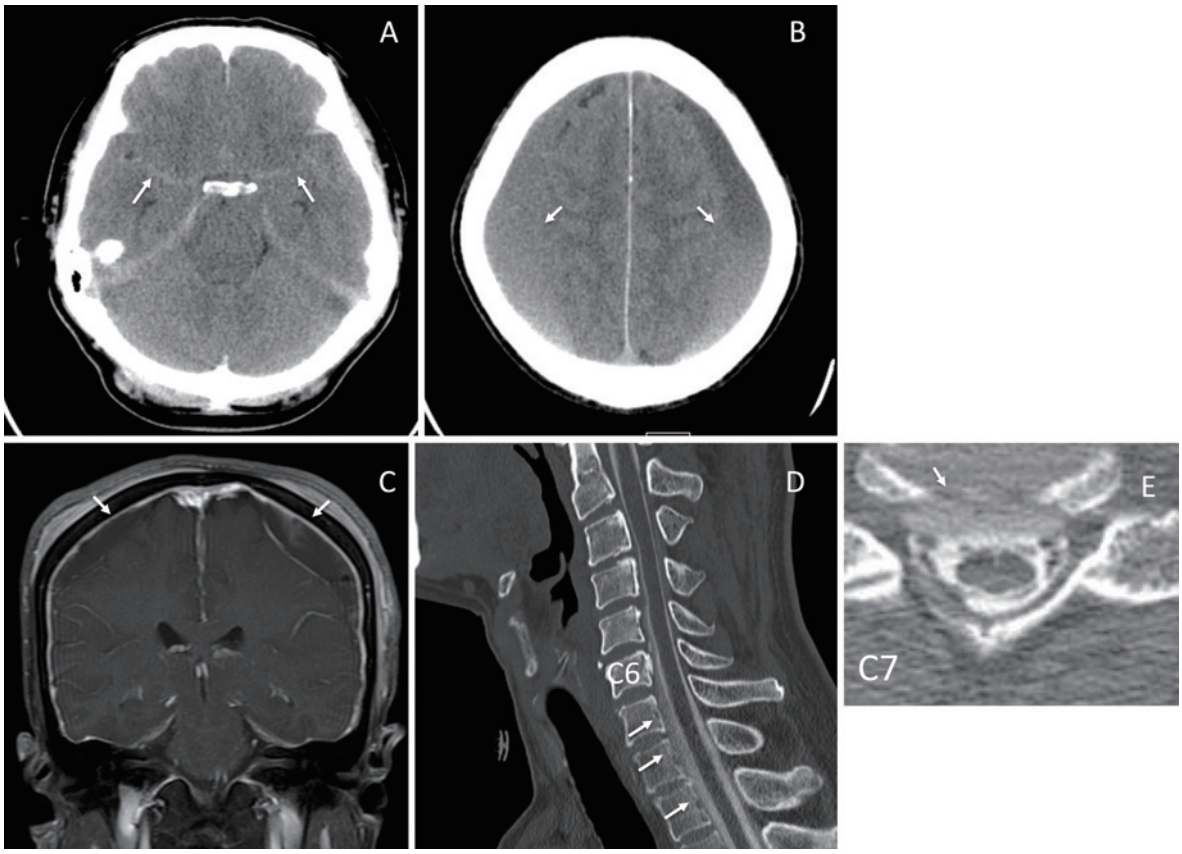

Fig. 1
A, B: Initial brain CT scan shows bilateral CSDH and pseudo-SAH.
C: Brain MRI shows diffuse pachymeningeal enhancement.
D, E: CT myelography reveals epidural contrast retention at the C6-T2 level.

Case Report

Case 1: A 55-year-old man without previous brain trauma presented to our hospital with a one-month history of headache and a two-day history of progressive disturbance in consciousness. The Glasgow Coma Scale was 7 (E1V1M5) upon arrival, and brain computed tomography (CT) scan showed bilateral CSDH (Fig. 1A-B). The patient received emergent bilateral hematoma drainage without irrigation, and his consciousness rapidly improved. However, a day postoperation, severe headache became apparent while standing. Brain magnetic resonance imaging (MRI) showed diffuse gadolinium pachymeningeal enhancement, and CT myelography revealed epidural contrast retention from the sixth cervical vertebra to the second thoracic vertebra (C6-T2) level, consistent with a clinical diagnosis of bilateral CSDH caused by SIH (Fig. 1C-E). Two weeks after the initial surgery, mild disturbance in his consciousness was noted (GCS13: E3V4M6). CT scan showed re-enlargement of the bilateral CSDH, so bilateral hematoma drainage was repeated. In this second surgery, an ICP sensor was also inserted through the left side burr-hole. Next, EBP was performed under fluoroscopy just after clamping both drainage catheters. Around 40 mL of autologous blood with contrast medium was injected into the epidural space between the T4-5 level. During the injection, the patient suffered from severe headaches due to increased ICP, so the drainage catheters were opened. Post operation, the drainage catheter was opened whenever headache with ICP elevation occurred. Immediate postoperative CT scan of the spine showed contrast medium in the epidural space (Fig. 2A). Brain CT scan on postoperative day one, after the removal of the drainage tube, showed a marked decrease in CSDH. ICP monitoring was continued until postoperative day two; after which, the ICP sensor was removed as no ICP elevation was observed. No recurrence of CSDH was noted, and his headache was cured (Fig. 2B-C). Perioperative course of case 1 is described in Fig. 2D.

Case 2: A 54-year-old man with no history of brain trauma visited our hospital because of persistent headache for one week. He was alert on arrival, and brain CT scan showed bilateral CSDH (Fig. 3A-B). Emergent left hematoma drainage without irrigation was performed, which improved the headache. However, a follow-up CT scan after two weeks showed enlargement of bilateral CSDH, so bilateral hematoma drainage was performed. A day after

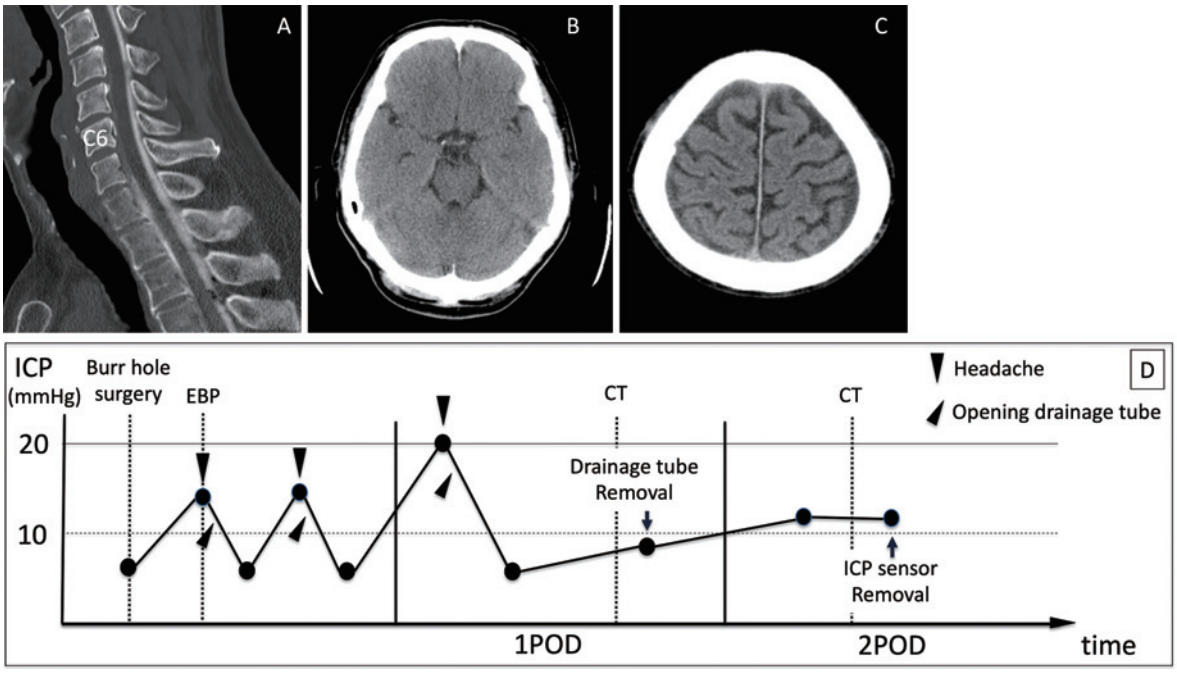

Fig. 2
A: Postoperative CT scan shows epidural contrast retention.
B, C: Brain CT scan 3 months after operation shows CSDH disappearance.
D: Time course of case 1.

the second surgery, his headache became apparent when standing. Brain MRI showed diffuse pachymeningeal enhancement, and CT myelography revealed epidural contrast retention at the T2-8 level (Fig. 3C-E). Thus, left hematoma drainage and ICP monitor insertion, followed by EBP under fluoroscopy with clamping of the drainage catheter, was done. Around 40 mL of autologous blood with contrast medium was injected into the epidural space at the T11-12 level. The drainage catheter was opened when headache with ICP elevation occurred. Postoperative spine CT scan showed the contrast medium in the epidural space (Fig. 4A). Brain CT scan on postoperative day one showed a marked decrease in CSDH. The ICP sensor was then removed as no ICP elevation was observed. No recurrence of CSDH was noted, and his headache was cured (Fig. 4B-C). Perioperative course of case 2 is described in Fig. 4D.

These two patients gave informed consent for the publication of this report.

Discussion

Chronic subdural hematoma (CSDH) is one of the most common intracranial hemorrhages in the elderly aged over 70 and has a good prognosis if treated appropriately.[5,6] Symptoms of patients with CSDH are neurological deficits associated with brain compression in 46%-63% of CSDH cases and headache due to increased ICP in 32%-62% of cases.[7-9] Diagnosis of a typical CSDH is easily done with brain CT scan or MRI, while the diagnosis of rare cases of CSDH associated with SIH is relatively difficult. For the diagnosis of typical SIH, which is characterized by a headache that worsens on standing, a combination of contrast-enhanced brain MRI and CT scan or MR myelography is recommended.[10,11] About 35% of cases show subdural fluid collection occurring as intracranial lesion.[3] Furthermore, the diagnosis of SIH alone takes an average of five days, whereas, the diagnosis of SIH-associated CSDH takes an average of 22 days. This is likely because the presenting symptom, particularly the headache, was similar in SIH and CSDH.[12] The report showed that 59% of patients with SIH-associated CSDH underwent hematoma drainage of CSDH at first. Some clues that may suggest SIH-associated CSDH are age < 55 years, no underlying disease, a small amount of hematoma, brain-sag, and pseudo-subarachnoid hemorrhage.[13]

Treatment methods and procedures differ depending on the individual's condition. Some cases of SIH-associated CSDH were resolved after EBP alone.[14] In another case, disturbance in consciousness due to rapidly increased ICP occurred after EBP; emergent hematoma drainage was required.[4] There have also been reports that hematoma drainage was performed without a diagnosis of SIH, causing a sudden ICP drop and disturbance in consciousness.[1,2] To prevent these outcomes, a treatment algorithm for SIH-associated CSDH was proposed by Takahashi et al.[15] Con-

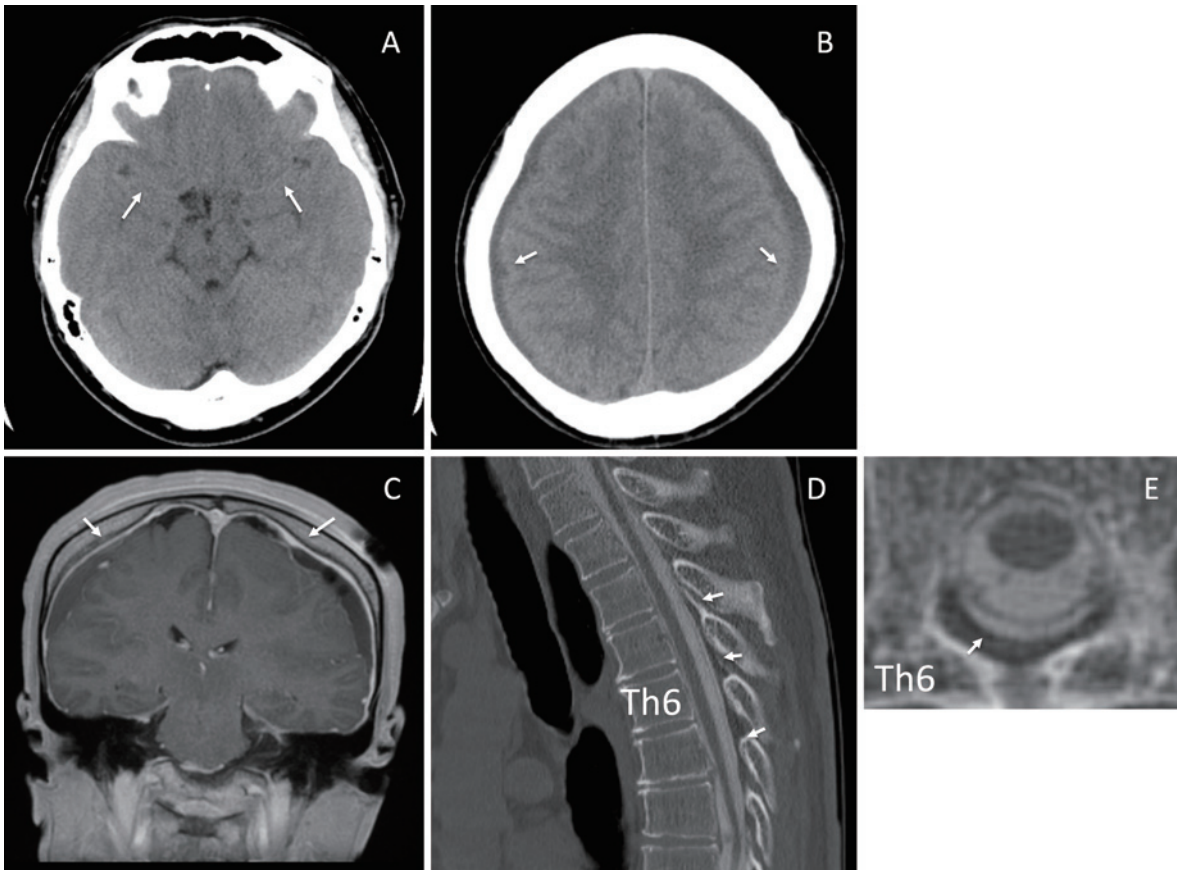

Fig. 3
A, B: Initial brain CT scan shows bilateral CSDH and pseudo-SAH.
C: Brain MRI shows diffuse pachymeningeal enhancement.
D, E: CT myelography reveals epidural contrast retention at the Th2-Th8 level.

servative treatments were the first choices. EBP and hematoma drainage were performed in large CSDH cases. Only EBP was performed in small CSDH cases; however, hematoma drainage was added if there was no improvement.

A treatment algorithm for SIH with disturbance in consciousness has also been proposed by Loya et al.[16] Patients with anisocoria, hematoma with mass effect, and no improvement in the conscious level in the Trendelenburg position were treated with EBP after hematoma drainage. Patients with improved consciousness in the Trendelenburg position were treated with EBP alone. Previous studies showed that the basic treatment for SIH-associated CSDH is performing hematoma drainage after or near simultaneously during EBP.

Our treatment method for SIH-associated CSDH is at first hematoma drainage and next EBP. Coombs et al. reported that the mean subarachnoid pressure increased and remained higher than 65 mmH_2O 15 minutes after EBP.[17] This acute elevation of ICP can cause deterioration of consciousness or other symptoms. If drainage and ICP monitoring is performed first, ICP elevation can be detected earlier and appropriate treatment can be administered. Moreover, the worsening of a patient's headache during EBP could be eased at that moment by opening drainage, as in our cases. The risk of priority hematoma drainage in ICP decrease before EBP. To prevent acute ICP decrease as much as possible, we did not aspirate the hematoma or irrigate with saline when the drainage tube was inserted. EBP should be performed immediately after drainage of CSDH.

The treatment we performed consisted of visualizing the ICP, appropriately evaluating the intracranial environment, and safely controlling the ICP. Previously, an ICP monitor was inserted during EBP for SIH,[18] and ICP monitoring was performed before direct suturing of the spinal cord dura leak.[19] In our cases, hematoma drainage and the ICP monitor insertion were performed before EBP for SIH-associated CSDH as follows: 1) The hematoma drainage tube was inserted without hematoma removal to prevent sudden ICP drop; 2) The ICP monitor was inserted at the same time to objectively determine whether the headache was caused by an increased ICP; 3) The ICP was easily controlled for immediate hematoma removal with increased ICP by stopping cerebrospinal fluid leakage; and 4)

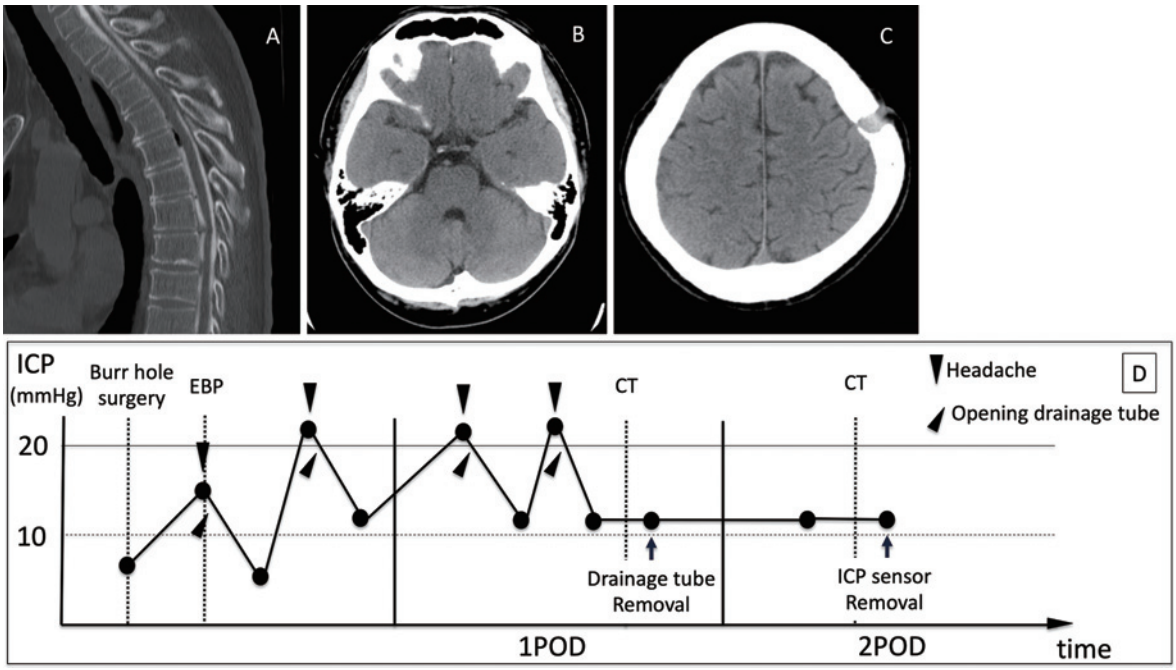

Fig. 4
A: Postoperative CT scan shows epidural contrast retention.
B, C: Brain CT scan 3 months after operation shows CSDH disappearance.
D: Time course of case 2.

The pathology of post-drainage headache could be predicted without imaging. We safely managed ICP and controlled headache by monitoring ICP in both cases. Additionally, inserting the ICP sensor is easy using the burr-hole of CSDH drainage. Perioperative management for SIH with large CSDH is made safer by ICP monitoring. In this study, both cases were diagnosed with SIH after the first hematoma drainage of CSDH. As the symptoms by the enlargement of CSDH became apparent, second drainage and EBP were performed during the same session. Futhermore, also in cases of SIH-associated CSDH diagnosed at first without drainage surgery, this treatment plan with ICP monitoring could be implemented. Patients with bilateral CSDH and relatively young patients without head trauma or traumatic CSDH risk factor should be assessed using contrast-enhanced brain MRI to identify the possibility of SIH.

The limitation of this report is that this treatment management is only for cases of SIH with large CSDH. Many SIH cases with small CSDH are curable only with a blood patch without the insertion of an ICP monitor. However, the blood patch for SIH-associated CSDH sometimes causes acute deterioration due to ICP elevation, and we should pay attention to these cases and accumulate such reports.

Conclusion

We report two cases of SIH with bilateral CSDH treated with EBP after hematoma drainage and ICP monitoring. By monitoring ICP before EBP, the ICP was safely controlled and CSDH was resolved. Appropriate diagnosis and treatment considering ICP monitoring are important for SIH with bilateral CSDH.

Abbreviations

CSDH: Chronic subdural hematoma
CT: Computed tomography
EBP: Epidural blood patch
ICP: Intracranial pressure
MRI: Magnetic resonance imaging
SIH: Spontaneous intracranial hypotension

CRediT Authorship Contribution Statement

All authors contributed to the treatment of patients. TT wrote the manuscript and contributed to ethical approval. AO, YM, EI revised and edited the manuscript. All authors read and approved the manuscript.

Funding Sources

This research did not receive any specific grant from

funding agencies in the public, commercial, or non-profit sectors.

Conflicts of Interest Disclosure

The authors have no conflicts of interest and have registered online self-reported COI disclosure statement forms through the website for The Japan Neuro-surgical Society members.

References

1) Chotai S, Kim JH, Kim JH, Kwon TH: Brain herniation induced by drainage of subdural hematoma in spontaneous intracranial hypotension. *Asian J Neurosurg* 8: 112-115, 2013
2) Haku T, Motoyama Y, Takamura Y, et al.: Central herniation induced by craniotomy prompting air replacement for subdural fluid collection due to cerebrospinal fluid hypovolemia. *World Neurosurg* 117: 182-185, 2018
3) D'Antona L, Jamie Merchan MA, Vassiliou A, et al.: Clinical presentation, investigation findings, and treatment outcomes of spontaneous intracranial hypotension syndrome: a systematic review and meta-analysis. *JAMA Neurol* 78: 329-337, 2021
4) Matsuoka K, Nakai E, Kawanishi Y, Kadota T, Fukuda H, Ueba T: Acute deterioration in a patient with bilateral chronic subdural hematomas associated with intracranial hypotention treated with an epidural blood patch. *World Neurosurg* 141: 331-334, 2020
5) Gelabert-Gonzales M, Iglesias-Pais M, Garcia-Allut A, Martinez-Rumbo R: Chronic subdural hematoma: surgical treatment and outcome in 1000 cases. *Clin Neurol Neurosurg* 107: 223-229, 2005
6) Toi H, Kinoshita K, Hirai S, et al.: Present epidemiology of chronic subdural hematoma in Japan: Analysis of 63,358 cases recorded in a national administrative database. *J Neurosurg* 128: 222-228, 2018
7) Mori K, Maeda M: Surgical treatment of chronic subdural hematoma in 500 consecutive cases: clinical characteristics, surgical outcome, complications, and recurrence rate. *Neurol Med Chir (Tokyo)* 41: 371-381, 2001
8) Kim J, Moon J, Kim T, et al.: Risk factor analysis for the reccurence of chronic subdural hematoma: a review of 368 consecutive surgical cases. *Korean J Neurotrauma* 11: 63-69, 2015
9) Rauhala M, Helen P, Heikkila P, et al.: Chronic subdural hematoma-incidence, complications, and financial impact. *Acta Neurochir (Wein)* 162: 2033-2043, 2020
10) Schievink WI, Dodick DW, Mokri B, Silberstein S, Bousser MG, Goadsby PJ: Diagnotid criteria for headache due to spontaneous intracranial hypotention: a perspective. *Headache* 51: 1442-1444, 2011
11) Schievink WI, Maya MM, Louy C, Moser FG, Tourje J: Diagnostic criteria for spontaneous spinal CSF leaks and intracranial hypotesion. *AJNR Am J Neuroradiol* 29: 853-856, 2008
12) Kim YJ, Cho HY, Seo DW, et al.: Misdiagnosis of spontaneous intracranial hypotention as a risk factor for subdural hematoma. *Headache* 57: 1593-1600, 2017
13) Kim JH, Roh H, Yoon WK, et al.: Clinical features of patients with spontaneous intracranial hypotention complicated with bilateral subdural fluid collections. *Headache* 59: 775-786, 2019
14) Rettenmaier LA, Park BJ, Holland MT, et al.: Value of targeted epidural blood patch and management of subdural hematoma in spontaneous intracranial hypotention: case report and review of the literature. *World Neurosurg* 97: 27-38, 2017
15) Takahashi K, Mima T, Akiba Y: Chronic subdural hematoma associated with spontaneous intracranial hypotention: therapeutic strategies and outcomes of 55 cases. *Neurol Med Chir (Tokyo)* 56: 69-76, 2016
16) Loya JJ, Mindea SA, Yu H, Venkatasubramanian C, Chang SD, Burns TC: Intracranial hypotention producing reversible coma: a systematic review, including three new cases. *J Neurosurg* 117: 615-628, 2012
17) Coombs DW, Hooper D: Subarachnoid pressure with epidural blood "patch". *Reg Anesth* 4: 3-6, 1979
18) Zada G, Pezeshkian P, Giannotta S: Spontaneous intracranial hypotention and iimediate implovent following epidural blood patch placement demonstrated by intracranial pressure monitoring. *J Neurosurg* 106: 1089-1090, 2007
19) Takai K, Taniguchi M: Intracranial hypotention with coma: microsurgical repair of a spirnal ventral dura tear and drainage of subdural hematoma with intracranial pressure monitoring. *World Neurosurg* 118: 269-273, 2018

Corresponding author: Toshitsugu Terakado, MD
Department of Neurosurgery, Koyama Memorial Hospital, 5-1-2 Kuriya, Kashima, Ibaraki 314-0030, Japan.
e-mail: toshi_0211jp@yahoo.co.jp