online © ML Comm
www.jkns.or.kr 10.3340/jkns.2010.47.6.424
J Korean Neurosurg Soc 47 : 424-427, 2010

Print ISSN 2005-3711 On-line ISSN 1598-7876

Clinical Article

What Determines the Laterality of the Chronic Subdural Hematoma?

Byoung-Gu Kim, M.D., Kyeong-Seok Lee, M.D., Jae-Jun Shim, M.D., Seok-Mann Yoon, M.D., Jae-Won Doh, M.D., Hack-Gun Bae M.D.
Department of Neurosurgery, Soonchunhyang University Cheonan Hospital, Cheonan, Korea

Objective : Chronic subdural hematomas (CSDH) are more common on the left hemisphere than on the right. We verified this left predilection of CSDH and tried to explain the reason for this discrepancy.
Methods : We investigated the laterality of CSDH in 182 patients who were treated from January 2005 to December 2009. We examined the symmetry of the cranium and the location of the lesion.
Results : CSDH was more common on the left-side. The cranium was symmetric in 63 patients, asymmetric in 119 patients. The asymmetric crania were flat on the right-side in 77 patients, on the left-side in 42 patients. The density of the CSDHs was hypodense in 29 patients, isodense 132 patients, and the others in 21 patients. Bilateral hematomas were more common in the hypodense group. In the right flat crania, the hematoma was more commonly located on the opposite side of the flat side. While in the left flat crania, the hematoma was more common on the same side.
Conclusion : CSDHs occurred more frequently on the left side. The anatomical asymmetry of the cranium influences the left predilection of CSDH.

KEY WORDS : Chronic subdural hematoma · Computed tomography · Craniocerebral trauma · Diagnosis · Laterality.

INTRODUCTION

Chronic subdural hematoma (CSDH) may occur on either side or both sides of the cranial space. However, actual distribution of CSDH is not equal in both sides. CSDHs are more commonly found on the left than on the right in many reports[2,5,8,16,18,21]. There was no statistically significant difference in terms of laterality in the acute or subacute subdural hematomas[16].

There are reports indicating that the laterality of the CSDH depends on the cranial morphology[2,12]. The brain is asymmetric in structure and function[6,10]. Like the brain, the cranium is frequently asymmetrical. The posterior region of the left hemisphere is more often larger than the right[3]. If it is true, the cranium is more often flat on the right side. The posture of the cranium tends to tilt to the flat side, and then the CSDH should theoretically be more often located on the left side. We evaluated the laterality of CSDH and tried to find the explanation for this discrepancy.

• Received : March 3, 2010 • Revised : April 30, 2010
• Accepted : May 23, 2010
• Address for reprints : Kyeong-Seok Lee, M.D.
Department of Neurosurgery, Soonchunhyang University Cheonan Hospital, 23-20 Bongmyeong-dong, Cheonan 330-721, Korea
Tel : +82-41-570-3652, Fax : +82-41-572-9297
E-mail : ksleens@hotmail.com

MATERIALS AND METHODS

From January 2005 to December 2009, we managed 182 patients with CSDH. We made the diagnosis by computed tomography (CT) in 162 patients. In 20 patients, the diagnosis of CSDH was made by the magnetic resonance imaging (MRI). We examined the symmetry of the cranium and the location of the lesion. The asymmetry of the cranium is checked by a simple method. We identified the flat side using three lines passing the midline and both sides of the cranium (Fig. 1). The side of the smaller angle is the flat side. For the purpose of this study, we defined the cranium asymmetrical, when the difference of the angles was bigger than 2 degrees.

The laterality of the hematoma was divided into either the opposite or the same. It was classified as the opposite when the hematoma was on the opposite of the flat side. It was classified as the same when the hematoma was on the

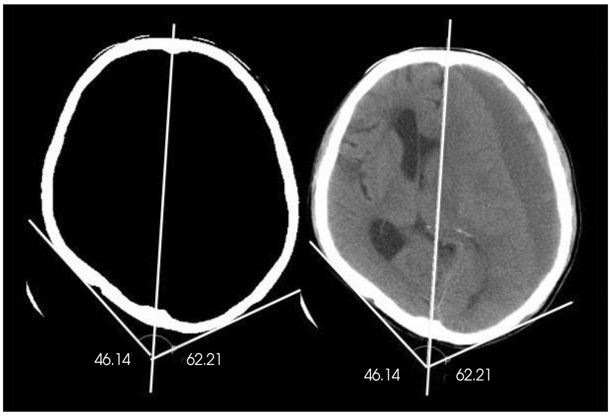

Fig. 1. The asymmetry of the cranium is checked by three lines passing the midline and both sides of the cranium. The side of the smaller angle is the flat side.

same side. In bilateral CSDHs, we classified the laterality according to the site of the larger hematoma.

According to the density (Hounsfield unit : HU), the hematomas were classified into hypodense (less than 20 HU), isodense (from 20 HU to 50 HU), and the other groups. The other included one calcified CSDH and 20 patients in whom the first diagnosis was made by MRI only.

Statistical significance was tested using the chi-square test. It was considered significant, when $p < 0.05$.

RESULTS

Symmetry of the cranium and laterality of the hematoma

The cranium was asymmetric in 119 (65.4%) patients. The asymmetric crania were flat on the right side in 77 patients and on the left side in 42 patients (Table 1). CSDH was more common on the left side. Bilateral CSDHs were slightly more common in the symmetric crania; however, this difference was not statistically significant.

Relation to the hematoma density and laterality

The density of the CSDHs was hypodense in 29 patients (15.9%), isodense 132 patients (72.5%), and the others in 21 patients (11.5%) (Table 2). Bilateral hematomas were more common in the hypodense group. Except the others group, this difference was statistically significant ($p = 0.013$).

Relation to the cranial morphology and laterality in asymmetric crania

In the right flat crania, the hematoma was more commonly located on the opposite side of the flat side. While in the left flat crania, the hematoma was more common on the same side (Table 3). This difference based on the cranial morphology was statistically significant ($p = 0.008$). In 41 patients with the same side hematomas, the CSDH was originated from the acute subdural hematoma (ASDH) on the same side in three cases. However, in the remaining 38 patients, we could not find any corresponding reasons of the same side.

Table 1. Symmetry of the cranium and laterality of the hematoma

Laterality	Symmetric	Asymmetric	Subtotal (%)
Right	21	36	57 (31.3)
Left	30	62	92 (50.5)
Bilateral	12	21	33 (18.1)
Subtotal (%)	63 (34.6)	119 (65.4)	182 (100)

$p = 0.847$ by the chi-square test

Table 2. Density and laterality of the hematoma

Laterality	Hypodense	Isodense	Others	Subtotal (%)
Right	6	41	10	57 (31.3)
Left	12	70	10	92 (50.5)
Bilateral	11	21	1	33 (18.1)
Subtotal (%)	29 (15.9)	132 (72.5)	21 (11.5)	182 (100)

$p = 0.013$ by the chi-square test except others

Table 3. Cranial morphology and laterality of hematoma in asymmetric crania

Location	Left	Right	Subtotal (%)
Opposite	16	52	68 (13.4)
Same	21	20	41 (17.6)
Bilateral	5	5	10 (4.2)

$p = 0.008$ by the chi-square test

The origin of CSDH and laterality of the hematoma

The origin of CSDH was identified as the ASDH by the serial CT scans in 12 patients. The crania were asymmetric in eight of them. Among them, the hematoma was on the opposite side in four, on the same side in two, and bilateral in two patients. In four symmetric crania, the hematoma was on the left in three and right in one patient. There was no corresponding laterality in CSDHs resulting from ASDHs.

In 24 patients, the origin of CSDH was identified as the subdural hygroma (SDG) by the serial CT scan. The crania were asymmetric in 17 of them. Among them, the hematoma was on the opposite side in 11, on the same side in five, and bilateral in one patient. In 7 symmetric crania, the hematoma was on the right in one, left in three, and bilateral in three patients. CSDHs from SDGs tend to locate on the opposite side.

DISCUSSION

CSDH was more common on the left side in this study as CSDHs occurred more frequently on the left side[2,5,8,16,18,21]. Even in strokes, the left hemispheric events was more common than the right[4]. MacFarlane et al.[16] suggested that the right-sided lesions were likely to be documented less frequently as a result of the underdiagnosis of these lesions rather than a true increase in left-sided lesions.

The cranium was more commonly asymmetric in this study. The asymmetric crania were more commonly flat on the right side than on the left side. The human brain is asymmetric in structure and function[10]. Morphological left-right asymmetry appears to be the rule, rather than the exception in biological systems[6]. Structural asymmetries in the human brain and observations of macroscopic structural asymmetries in areas known to be functionally asymmetric have proliferated in the past two decades[6]. The main and most consistent observations include the right frontal and left occipital petalia; marked indentations of the inner table of the skull resulting from the greater protrusion of the adjacent cerebral lobes[3,6]. The left occipital pole is frequently wider and protrudes further posterior than the right[3,7,9,11]. If the posterior region of the left hemisphere is more often larger than the right[3], the posture of the cranium tends to tilt to the flat side. Then the left side of the cranium would be the top, when a man lies on his back. CSDHs frequently originate from SDGs[13,15,20]. SDGs usually locate on the top of the head[14]. CSDHs originated from SDGs will locate on the left side. Since CSDH frequently originate from SDG, the laterality of CSDH is influenced by the gravity and cranial posture. The anatomical asymmetry of the cranium is the cause of the left prevalence of CSDH.

The method measuring cranial asymmetry is quite simple. The midline is a line passing both crista gali and internal occipital protuberance. From a point on the midline, we draw two lines passing the most prominent part of skull on both sides. If the distance from the point to the external occipital protuberance is too much long, the difference of the angles would be smaller. However, we could measure the overt asymmetry by this simple method. Minute asymmetry may not cause head tilting.

We identified that the hematoma was more commonly located on the opposite side to the flat side in the right flat crania. However, when the cranium was flat on the left side, the hematoma was more commonly on the same side in this study. Although a few ASDH may occur at the same side, it is not easy to explain these exceptional cases. If strokes were more common in the left hemisphere than the right[4], atrophic changes of the brain is more severe in the left hemisphere. Theoretically, if the atrophic change of the brain progresses, reduction of the cerebral mass in the left hemisphere exceeds the right side, which may create intracranial pressure difference. If the pressure of the left hemisphere is lower than the right, SDGs will locate on the left side, since SDGs usually occur at the least pressure in the cranium as a lesion of ex vacuo. Premorbid condition producing a space of the least pressure is most important for the development or recurrence of CSDH. The only factor associated with recurrence of CSDH was the re-expansion rate at one week after the surgery[18]. An upright posture soon after burr-hole surgery was associated with a significantly increased incidence of CSDH recurrence[1,17,19]. A bilateral SDG becomes a unilateral CSDH by pressure difference produced by either dynamics between expansion and resorption or tilting of the cranium[13].

The density of the CSDHs was most often isodense in this study. The age of the isodense hematoma is older than the hypodense hematoma[12]. The density of the CSDH originated from SDGs would be hypodense at first. That is the reason why bilateral hematomas were more common in the hypodense group in this study. Even the hyperdense ASDHs usually become hypodense within 3 weeks[12]. Then, it becomes isodense by the repeated microhemorrhage, which is the mechanism of enlargement of CSDH[12]. The laterality of CSDH is dependent on the initial site of ASDH and pressure difference produced by either dynamics between expansion and resorption or tilting of the cranium.

CONCLUSION

In our study, the CSDHs occurred more frequently on the left side. The anatomical asymmetry of the cranium is considered to influence the left prevalence of CSDH.

References

1. Abouzari M, Rashidi A, Rezaii J, Esfandiari K, Asadollahi M, Aleali H, et al. : The role of postoperative patient posture in the recurrence of traumatic chronic subdural hematoma after burr-hole surgery. **Neurosurgery 61** : 794-797; discussion 797, 2007
2. Akhaddar A, Bensghir M, Elmoustarchid B, Abouqal R, Boucetta M : Influence of cranial morphology on the location of chronic subdural hematoma. **Acta Neurochir (Wien) 151** : 1235-1240, 2009
3. Chiu HC, Damasio AR : Human cerebral asymmetries evaluated by computed tomography. **J Neurol Neurosurg Psychiatry 43** : 873-878, 1980
4. Foerch C, Misselwitz B, Sitzer M, Berger K, Steinmetz H, Neumann-Haefelin T, et al. : Differences in recognition of right and left hemisphere stroke. **Lancet 366** : 392-393, 2005
5. Gelabert-González M, Iglesias-Pais M, García-Allut A, Martínez-Rumbo R : Chronic subdural haematoma : surgical treatment and outcome in 1000 cases. **Clin Neurol Neurosurg 107** : 223-229, 2005
6. Good CD, Johnsrude I, Ashburner J, Henson RN, Friston KJ, Frackowiak RS : Cerebral asymmetry and the effects of sex and handedness on brain structure : a voxel-based morphometric analysis of 465 normal adult human brains. **Neuroimage 14** : 685-700, 2001
7. Hervé PY, Crivello F, Perchey G, Mazoyer B, Tzourio-Mazoyer N : Handedness and cerebral anatomical asymmetries in young adult males. **Neuroimage 29** : 1066-1079, 2006
8. Ko BS, Lee JK, Seo BR, Moon SJ, Kim JH, Kim SH : Clinical analy-

sis of risk factors related to recurrent chronic subdural hematoma. **J Korean Neurosurg Soc 43** : 11-15, 2008
9. Koff E, Naeser MA, Pieniadz JM, Foundas AL, Levine HL : Computed tomographic scan hemispheric asymmetries in right- and left-handed male and female subjects. **Arch Neurol 43** : 487-491, 1986
10. Kovalev VA, Kruggel F, von Cramon DY : Gender and age effects in structural brain asymmetry as measured by MRI texture analysis. **Neuroimage 19** : 895-905, 2003
11. Le May M, Kido DK : Asymmetries of the cerebral hemispheres on computed tomograms. **J Comput Assist Tomogr 2** : 471-476, 1978
12. Lee KS, Bae WK, Bae HG, Doh JW, Yun IG : The computed tomographic attenuation and the age of subdural hematomas. **J Korean Med Sci 12** : 353-359, 1997
13. Lee KS, Bae WK, Yoon SM, Doh JW, Bae HG, Yun IG : Location of the chronic subdural hematoma : role of the gravity and cranial morphology. **Brain Inj 15** : 47-52, 2001
14. Lee KS, Bae WK, Yoon SM, Doh JW, Bae HG, Yun IG : Location of the traumatic subdural hygroma : role of gravity and cranial morphology. **Brain Inj 14** : 355-361, 2000
15. Lee KS, Doh JW, Bae HG, Yun IG : Relations among traumatic subdural lesions. **J Korean Med Sci 11** : 55-63, 1996
16. MacFarlane MR, Weerakkody Y, Kathiravel Y : Chronic subdural hematomas are more common on the left than on the right. **J Clin Neurosci 16** : 642-644, 2009
17. Miele VJ, Sadrolhefazi A, Bailes JE : Influence of head position on the effectiveness of twist drill craniostomy for chronic subdural hematoma. **Surg Neurol 63** : 420-423; discussion 423, 2005
18. 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
19. Nakajima H, Yasui T, Nishikawa M, Kishi H, Kan M : The role of postoperative patient posture in the recurrence of chronic subdural hematoma : a prospective randomized trial. **Surg Neurol 58** : 385-387; discussion 387, 2002
20. Park SH, Lee SH, Park J, Hwang JH, Hwang SK, Hamm IS : Chronic subdural hematoma preceded by traumatic subdural hygroma. **J Clin Neurosci 15** : 868-872, 2008
21. Santarius T, Kirkpatrick PJ, Ganesan D, Chia HL, Jalloh I, Smielewski P, et al. : Use of drains versus no drains after burr-hole evacuation of chronic subdural hematoma : a randomised controlled trial. **Lancet 374** : 1067-1073, 2009