

Effectiveness of Early Surgery in Children with Traumatic Subdural Hygroma

Byoung Ook Kim, M.D., Seok Won Kim, M.D., Seung Myung Lee, M.D.

Department of Neurosurgery, College of Medicine, Chosun University, Gwangju, Korea

Objective : This study was performed to evaluate the usefulness of early operation in children with traumatic subdural hygroma.

Methods : The subjects were nine patients (Glasgow coma scale (GCS) score was below 10 and age was below 10 years old) who developed subdural hygroma after trauma between January 2000 to December 2002. Subduroperitoneal shunt was performed in one group and not performed in the other group. We analyzed the GCS score on admission and at 1 year after operation. Overall clinical results were evaluated retrospectively.

Results : Patients who underwent operation exhibited higher GCS scores at 1 year after trauma compared to those in the patients who were treated by conservative therapy ($p < 0.05$).

Conclusion : The early operation could be an effective treatment to children with subdural hygroma who showed delayed improvement of consciousness and to patients with hygroma that didn't decrease or was above moderate amount.

KEY WORDS : Early operation · Traumatic subdural hygroma · Child · Subduroperitoneal shunt.

Introduction

Child's brain is characteristically different from that of an adult, thus children would show different clinical findings and course after head trauma. Furthermore, child's brain is easily compressed so that it is easier to secure spaces for fluid collection due to brain atrophy after head trauma²⁾. The natural progression of subdural hygroma developed secondarily after trauma has not been elucidated in children so that this lesion has been easily overlooked. In many cases, simple subdural hygroma has been treated conservatively since it shows the clinical symptoms such as delayed recovery of mental status without neurologic deficit or headache and is reduced in size or resolved spontaneously with time^{3,6,13,18,19)}. However, Lee et al.^{10,11)} reported that massive subdural hygroma having a mass effect requires surgical treatment because it could delay recovery of consciousness. And children should be treated different to adults because child's brain grows and shows fast recovery, plasticity. We performed surgery in children with subdural hygroma developed after serious head trauma and obtained good outcomes. Based on these results, we propose the guidelines to treat those patients.

- Received : June 8, 2004 • Accepted : September 30, 2004
- Address for reprints : Seung Myung Lee, M.D., Department of Neurosurgery, College of Medicine, Chosun University, 588 Seoseok-dong, Dong-gu, Gwangju 501-717, Korea
- Tel : +82.62-220-3120, 3126, Fax : +82.62-227-4575
- E-mail : chosunns@hanmail.net

Materials and Methods

Among 72 children under 10 years old who were treated at our hospital from January 2000 to December 2002 due to head trauma, we analyzed 11 subjects who developed surgically indicated subdural hygroma. Surgical indication was that the patients below GCS score 10 showed delayed improvement of consciousness and the amount of hygroma did not decrease or was above moderate. The patients who had few amount of hygroma and recovered gradually, expired during admission were excluded. Most of the injuries were attributed to traffic accidents and other causes included fall down and child abuse. The subjects included seven males and four females, who were followed up for 3 weeks to 4 years, with an average follow-up period of 17 months. Subdural hygroma was confirmed using radiographic findings of brain CT and MRI. In six children who's parents agreed with operation, subduroperitoneal shunt was performed and five children who's parents refuse operation were treated conservatively. Based on the clinical records, we investigated the age, GCS score on admission and before operation and at 1 year after trauma, the time interval between trauma to subdural hygroma detection, amount of subdural hygroma, surgical method (Table 1).

Statistical analysis was performed with Mann-Whitney U-test of non-parametric statistics using the Statistical Package for Social Science Statview Package (SPSS Inc., Chicago, IL, USA) with a p-value < 0.05 considered to be statistically significant.

Results

The mean age of the children was 6 years, ranged from 5 months to 10 years. The sex ratio of male to female was 1.75:1. The average GCS score was 7 at the time of initial visit, ranged from 5 to 10. The average time taken to detect subdural hygroma after head injury was 49 days, ranged from 2 to 78 days. Subdural hygroma was bilateral in nine children, affecting the fronto-temporo-parietal area and was in the right fronto-temporo-parietal area in two children (Table 1). The amount of hygroma ranged from moderate to severe, leading to mass effect, eight and three respectively. All eleven subjects didn't present specific changes in neurologic symptoms at the time of subdural hygroma detection and hygroma was found accidentally in follow up CT. The average time taken to operate was 8.4 days, ranged from 3 to 11. Two out of six who underwent surgery showed a mass effect on brain imaging and the amount of subdural hygroma in the other four children did not decrease

or rather increased for follow up (Fig. 1). Subdural hygroma progressed into chronic subdural hematoma in three out of five children who did not undergo surgery (Fig. 2). In one child subdural hygroma didn't change and in another one it was absorbed. No correlation was seen between the GCS score on admission and at the development of subdural hygroma. Subduroperitoneal shunt was performed in all six cases. Patients who underwent operation exhibited higher GCS scores at 1 year after trauma compared to those in the patients who were treated by conservative therapy ($p < 0.05$) (Table 1).

Discussion

Subdural hygroma is the condition where cerebrospinal fluid or xanthochromic or slightly blood tinged fluid is accumulated in the subdural space with the breakage of meninges-subarachnoid barrier after trauma. In most cases of subdural hygroma blood is mixed with CSF. Although the

mechanism of how subdural hygroma develops is uncertain, it is known that spinal fluid would leak from the subarachnoid space to the subdural space with arachnoid membrane breakage resulting from head trauma^{1,5,7,12}. Another possibility proposed is that subdural hygroma results from injury due to deceleration or is an epiphenomenon with increased vascular permeability in the Sylvian veins or cortical capillaries/arterioles^{4,14,18}.

For the development of subdural hygroma, it is necessary that the meninges-subarachnoid barrier is broken and a sufficient space is created to accumulate body fluid in the subdural area. The separation of the meninges-subarachnoid barrier, in which is the start of subdural hygroma, does not occur normally but could occur after head injury or brain surgery. These subdural hygroma is seen frequently with cerebral injury in 0.81~13% of the patients with brain injury, regardless of the degree and site of brain injury^{15,17,18}. Koizumi et al.⁹ found subdural hygroma in 17% of

Table 1. Summary of patients suffering from a subdural hygroma

Age/Sex	GCS score			Admission CT	Hygroma interval (day)	Hygroma location	Treatment
	On admission	Before operation	After 1 year				
4/M	5	5	9	Normal	2	Bilateral	Operation
10/M	7	8	13	Normal	32	Bilateral	Operation
7/F	6	7	12	SDH	50	Bilateral	Operation
2/M	7	7	13	ICH	27	Bilateral	Operation
7/M	6	6	13	Normal	28	Rt. F-T-P	Operation
7/F	8	10	12	Normal	78	Bilateral	Operation
6/F	6		9	Skull Fracture	35	Bilateral	Conservative
8/M	5		8	Normal	61	Bilateral	Conservative
5/M	7		11	Normal	40	Rt. F-T-P	Conservative
5Mo/M	9		12	Normal	30	Bilateral	Conservative
9/F	10		15	SAH	68	Bilateral	Conservative

GCS : Glasgow coma scale, CT : Computed tomography, SDH : Subdural hematoma, ICH : Intracerebral hematoma, SAH : Subarachnoid hemorrhage, Rt : Right, F-T-P : Fronto-temporo-parietal, Mo : Months

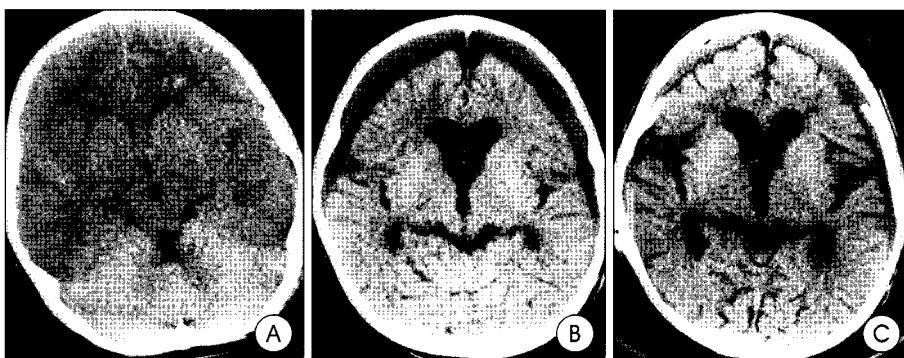


Fig. 1. A 2-year-old patient. Brain computed tomography(CT) scans performed on 2nd day after traffic accident shows punctate hemorrhage on the left frontal white matter (A). Follow-up CT scan on 27th day after head injury shows bilateral symmetrical extraaxial hypodense areas (B). Subduro-peritoneal shunt was performed on 30th day after head injury. CT scan on postoperative 10th day shows decreased in size on both lesions (C).

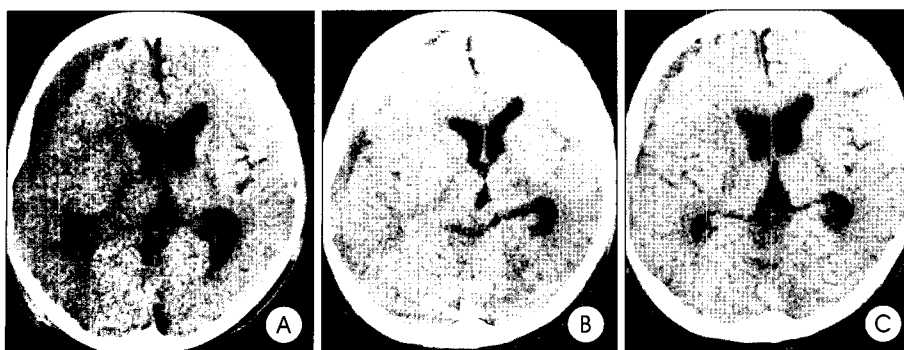


Fig. 2. An 8-year-old patient. Serial brain computed tomography(CT) scans showing the development of chronic subdural hematoma following traumatic subdural hygroma. In the right fronto-temporo-parietal area subdural hygroma is seen 32th day after head injury (A). Chronic subdural hematoma in the right frontotemporal area is seen in the scan performed on the 65th day after injury (B). A burr hole trephination and a closed external drainage had performed on 70th day. Scans on the postoperative 3rd day showing removal of hematoma (C).

1013 patients who underwent brain surgery due to brain lesion rather than trauma and reported that subdural hygroma could occur with brain atrophy, severe dehydration, increased intrathoracic pressure, and excess drug use to decrease intracranial pressure.

Brain atrophy develops easily after trauma in children and the elderly compared with adults since their brain is prone to be compressed. It is believed that the difference in time of subdural hygroma development after trauma would be significantly related with characteristics of brain injury. A prolonged phase of neurodegeneration has been demonstrated as long as 1 year after injury¹⁶⁾. Treatment of brain atrophy in traumatic brain injury is still a difficult and controversial problem.

Subdural hygroma on CT is usually seen in low density similar to cerebrospinal fluid, crescent-shape bilaterally in the frontal area. The fact that no contrast enhancement was seen with the injection of contrast material could be used to diagnose subdural hygroma from chronic subdural hematoma. Many studies reported the progression of subdural hygroma to chronic subdural hematoma. The reported incidence of subdural hygroma progressing to chronic subdural hematoma was 14% by Hong et al.⁶⁾, 25% by Yamada et al.²¹⁾, and 47% by Ohno et al.¹⁴⁾. The time of progression according to each author were 49~166 days, 29~76 days, and 8~116 days, respectively. Subdural hygroma progressed into chronic subdural hematoma in three out of five children who were not treated surgically, showing a transforming rate of 60% in this study.

The CNS development start early in the mother, the number of brain cells increases vertically until the time of birth and gradually until 6~12 months after birth. The immature brain grows fast, so that the brain weight in 6 months after birth is twice as the time of birth. By the end of 2 years, the weight of a child's brain is 75% of that of adult's. By 6~8 years, it's increase to about 90% of an adult's. Although neurons in the nervous

system cannot be replaced once damaged, new dendrites are developed to substitute for the lost neurons and when one afferent fiber is cut by injury, other afferent fibers spread terminally to the damaged perikaryon or synaptic end. The cell is programmed to receive a certain number of synapses so they tend to recover that amount when injured. This inherent characteristic plays a significant role in recovering brain function⁸⁾. This plasticity of nerve system is well shown through the finding that

the region of the brain responsible for language is already decided at the time of birth but if the right hemisphere is damaged or removed before 4~5 years of age, it is possible to recover language function²⁾. Child's brain grows at different rates compared with adult's brain and shows fast recovery. Thus, it is important to remove any factor that would hinder brain growth in children as soon as possible.

Some authors argued that subduroperitoneal shunt was best surgical method²⁰⁾. But, surgical treatment with the same method might bring about different results (burr hole with drainage 38~100%, subduroperitoneal shunt 30~100%) so it was difficult to define that surgical method affected postoperative results. And in surgical treatment of traumatic hygroma cases surgical treatment suitable to indication will be the best method for better postoperative outcomes as other neurosurgical disease. However, the reason for performing subduroperitoneal shunt was experience to remove the catheter for high infection risk in burr hole with drainage, and follow-up confirmed no reduction of subdural hygroma. It was judged that if there is no shunt infection, it can be kept for long time isolated from the outside till subdural hygroma is completely disappeared and subduroperitoneal shunt with lower danger of relapse of subdural hygroma was more effective for treating hygroma.

The results of this study showed that more active surgical treatment is effective to prognosis of subdural hygroma after following up 11 children younger than 10 years of age. However, improvement of consciousness according to natural history must be considered.

Conclusion

Child's brain grows and shows fast recovery, plasticity. Subdural hygroma could progress into chronic subdural

hematoma and spontaneous absorption does not occur in many cases. So we performed early operation for children with subdural hygroma who showed delayed improvement of consciousness and obtained the results that the operation group exhibited higher GCS scores at 1 year after trauma compared to those in the conservatively treated group. However, further studies are needed with more patients since the results of this study were obtained from a small group.

• Acknowledgement

This study was supported by research funds from Chosun University 1997.

References

1. Borzone M, Capuzzo T, Perria C, Rivano C, Tercero E : Traumatic subdural hygromas : a report of 70 surgically treated cases. **J Neurosurgical Sci** **27** : 161-165, 1983
2. Chugani HT, Muller RA, Dhugani DC : Functional brain reorganization in children. **Brain Dev** **18** : 347-356, 1996
3. French BN, Cobb CA 3rd, Corkill G, Youmans JR : Delayed evolution of posttraumatic subdural hygroma. **Surg Neurol** **9** : 145-148, 1978
4. Gutierrez FA, McLone DG, Raimondi AJ : Physiopathology and a new treatment of chronic subdural haematoma in children. **Childs Brain** **5** : 216-232, 1979
5. Hoff J, Bates E, Barnes B, Glickman M, Margolis T : Traumatic subdural hygroma. **J Trauma** **13** : 870-876, 1973
6. Hong DH, Lim HH, Bae WK, Kim PN, Kim IY, Lee BH, et al : Chronic subdural hematoma secondary to traumatic subdural hygroma. **Korean J Radiol** **30** : 219-224, 1994
7. Hughes M, Cohen WA : Radiographic evaluation. In **PR Cooper(editor) Head Injury**, ed 3. Baltimore : Williams and Wilkins, 1993, pp65-89
8. Jacobson M : Formation of dendrites and development of synaptic connections. In **Developmental Neurobiology**, ed 3. **New York** : Plenum Press, 1991, pp223-283
9. Koizumi H, Fukamachi A, Wakao T, Tasaki T, Nagaseki Y, Yanai Y : Traumatic subdural hygromas in adults : on the possibility of development of chronic subdural hematoma. **Neurol Med Chir** **21** : 397-406, 1981
10. Lee KS : The pathogenesis and clinical significance of traumatic subdural hygroma. **Brain Inj** **12** : 595-603, 1998
11. Lee KS, Bae WK, Bae HG, Yun IG : The fate of traumatic subdural hygroma in serial computed tomographic scans. **J Korean Med Sci** **15** : 560-568, 2000
12. Murata K : Chronic subdural hematoma may be preceded by persistent traumatic subdural effusion. **Neurologia Med Chir (Tokyo)** **33** : 691-696, 1993
13. Obada WG, Pitts LH : Management of head injury. Extracerebral lesions : **Neurosurg Clin N Am** **2** : 351-372, 1991
14. Ohno K, Suzuki R, Masaoka H : Chronic subdural hematoma preceded by persistent traumatic subdural fluid collection. **J Neurol Neurosurg Psychiatry** **50** : 1694-1697, 1987
15. Oka H, Motomochi M, Suzuki Y, Ando K : Subdural hygroma after head injury. A review of 26 cases. **Acta Neurochir** **26** : 265-273, 1972
16. Smith DH, Chen XH, Pierce JE, Wolf JA, Trojanowski JQ, Graham DI, et al : Progressive atrophy and neuron death one year following brain trauma in the rat. **J Neurotrauma** **14** : 715-727, 1977
17. Sohn IT, Lee KS, Doh JW, Bae HG, Yun IG, Byun BJ : A Prospective study on the incidence, patterns and premorbid conditions of traumatic subdural hygroma. **J Korean Neurosurg Soc** **26** : 87-93, 1997
18. Stone JL, Lang RG, Sugar O, Moody RA : Traumatic subdural hygroma. **Neurosurgery** **8** : 542-550, 1981
19. Takahashi Y, Mikami J, Sato H, Takeda S, Matsuoka T, Ito K, et al : Analysis of chronic subdural hematoma based on CT (part 2)-symptoms and CT findings. **Neurol Med Chir** **22** : 395-401, 1982
20. Todorow S, Happe M : Traumatic subdural hygromas. **Neurochirurgia (Stuttg)** **24** : 131-136, 1981
21. Yamada H, Nihei H, Watanabe T, Shibui S, Murata S : Chronic subdural hematoma occurring consequently to the posttraumatic subdural hygroma-On the pathogenesis of the chronic subdural hematoma. **No To Shinkei** **31** : 115-121, 1979