

Clinical Article

Postoperative Course and Recurrence of Chronic Subdural Hematoma

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Objective : Chronic subdural hematoma (CSDH) is known to have a significant recurrence rate. There are different criteria defining the recurrence of CSDH. We evaluated the postoperative course of CSDH and tried to propose the reasonable criteria of recurrence.

Methods : We retrospectively examined the medical records and pre- and postoperative CT scans of 149 consecutive patients who underwent surgery from January 2005 to December 2009. Diagnosis was confirmed by CT scanning or MRI. The postoperative courses were either resolved or recurrent. The resolved CSDH was one of the three types; early resolution, delayed resolution, or late resolution. The recurrent CSDH was one of the four types; recurrence without resolution, early recurrence after resolution, late recurrence after resolution, or recurrent-and-resolved type.

Results : The CSDH was resolved within 30 days after surgery in 58 (39%) patients, between 1 to 3 months in 62 (42%), and after 3 months in 11 (7%) patients. The CSDH was recurred in 18 (12%) patients. Late resolution or recurrence was more common in the aged. The recurrent hematoma was seen on the same side in 11 patients, on the different side in 7 patients. Recurrence was significantly more common in the thick hematomas.

Conclusion : For a working criteria of the recurrence of CSDH, we propose the early recurrence as return of symptoms or reaccumulation of the hematoma after a surgery within 3 months regardless of the location, amount or repeated operations. The late recurrence can be defined as reappearance or enlargement of a liquefied hematoma within the cranial cavity surrounded by the membranes or persistent CSDH beyond 3 months after surgery.

KEY WORDS : Chronic subdural hematoma · Craniocerebral trauma · Diagnosis · Recurrence · Risk Factors.

INTRODUCTION

Chronic subdural hematoma (CSDH) is known to have a significant recurrence rate. The rate of recurrence of chronic subdural hematoma after surgery ranges from roughly 5% to 30%^{1,7,16,18-20,22}. Many authors^{1,7,16,18-20,22} reported the recurrence rates of the CSDH, often without any criteria of the recurrence. There are some criteria defining the recurrence of CSDH, however, they are different from each other (Table 1)^{1,6,13,14,16-19,21,23}. The simplest criteria are re-accumulation of the hematoma within the postoperative hematoma cavity and the reappearance of neurological symptoms^{14,16}. However, the reappearance of neurologic symptoms is not always helpful to diagnose the recurrence. Because the symptoms of CSDH are often equivocal⁵, the diagnosis of a CSDH is not

usually suspected at the time of initial presentation in majority of cases^{2,4}. Residual fluid can be detected on computed tomography (CT) in as many as 80% of the patients, a majority of them is asymptomatic and clinically insignificant². It is difficult to differentiate the reaccumulation from the incomplete removal. There are no established criteria of recurrence, yet. We evaluated the postoperative course of CSDH and tried to propose the reasonable criteria of recurrence.

MATERIALS AND METHODS

We retrospectively examined the medical records and pre- and postoperative CT scans of 149 consecutive patients who underwent surgery from January 2005 to December 2009. Diagnosis was confirmed by CT scanning or MRI in all patients. The preferred surgical technique was single burr hole drainage (81%) under the local anesthesia. For the bilateral CSDHs, bilateral single burr hole drainage (15%) without irrigation was performed. Double burr holes with saline irrigation were used in only 3 patients (2%). Another 3 patients underwent a craniotomy. We placed a soft silicon drain in all

• Received : June 4, 2010 • Revised : September 2, 2010

• Accepted : December 28, 2010

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Table 1. Reported criteria of recurrence in chronic subdural hematomas

Authors	Year	Criteria of Recurrence
Nakaguchi et al.	2001	increase in the volume of the SDH on the operated side and the compression of the brain surface as observed in CT scans obtained within 3 months postoperatively, when compared with findings 1 day after surgery
Oishi et al.	2001	reaccumulation of the hematoma within the postoperative hematoma cavity and the reappearance of neurological symptoms
Rhode et al.	2002	hematoma re-accumulation and incomplete removal with persisting or recurrent symptoms
Yamamoto et al.	2003	increase in hematoma thickness and change in hematoma density on follow-up CT scans within 3 months postoperatively. Reappearance of symptoms also indicated the recurrence of hematoma
Gelabert-Gonzalez et al.	2005	increase in the volume of the CSDH on the operated side and the compression of the brain surface as observed in CT scans obtained prior to and after surgery
Abouzari et al.	2007	Clinical : change in mental status, worsening of the preexisting neurological or psychiatric illness, focal neurological deficit, and new-onset headache. Radiological: increased volume of subdural fluid on the treated side compared with the volume measured 1 to 3 days postsurgery and compressed brain by subdural fluid observed on CT scans obtained within 3 months after surgery
Ramachandran et al.	2007	reappearance of clinical symptoms and confirmed by CT scan
Weigel et al.	2007	persistent or progressive neurological deficit accompanied by a space-occupying subdural lesion on the previously operated side.
Torihashi et al.	2008	subsequent increase in hematoma volume in the ipsilateral subdural space with neurological deficits, which was followed by another operation
Santarius et al.	2009	occurrence of symptoms and signs attributable to an ipsilateral hematoma seen on a CT scan within 6 months of the original drainage procedure.

cases, which was usually removed within 2 days. We obtained postoperative CT scans within 3 days after surgery. Routine follow-up CT scans were done until regression of the subdural collection and their recovery to pre-morbid functional status.

The postoperative courses were either resolved or recurrent. The resolved CSDH was one of the three types : early resolution, delayed resolution and late resolution (Fig. 1). Early resolution (Type 1) was defined as resolution of the hematoma within 30 days after surgery. Delayed resolution (Type 2) was defined as resolution of the hematoma between 1 to 3 months (Fig. 2). Late resolution (Type 3) was defined as resolution of the hematoma after 3 months or more (Fig. 3). The recurrent CSDH was one of the four types; recurrence without resolution, early recurrence after resolution, late recurrence after resolution, and recurrent-and-resolved type (Fig. 4). Recurrence without resolution (Type 4) was defined as increased volume of the hematoma without resolution. Early recurrence after resolution (Type 5) was defined as recurrence of the resolved hematoma within 3 months after surgery. Late recurrence after resolution (Type 6) was defined as recurrence of the resolved hematoma after 3 months or more. There is one additional type of recurrence, the recurrent-and-resolved type (Type 7), which was the spontaneously resolved recurrent CSDH.

The thickness of the hematoma was measured on CT scan, which revealed the maximal thickness of the hematoma¹⁵⁾. The degree of midline shift was measured near the level of the third ventricle or septum pellucidum on CT scan.

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

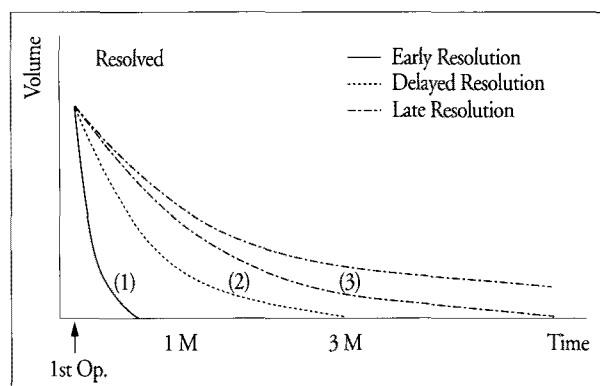


Fig. 1. Postoperative course of the resolved chronic subdural hematoma. Early resolution is defined as resolution of the hematoma within 30 days after surgery (1). Delayed resolution is defined as resolution of the hematoma between 1 to 3 months (2). Late resolution is defined as resolution of the hematoma after 3 months or more (3).

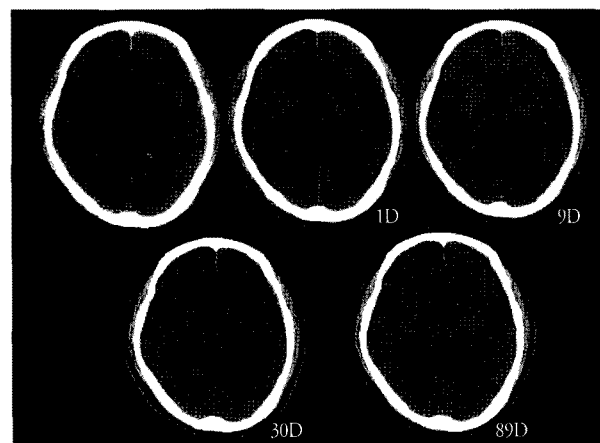


Fig. 2. An example of a delayed resolution. The hematoma is resolved within 3 months.

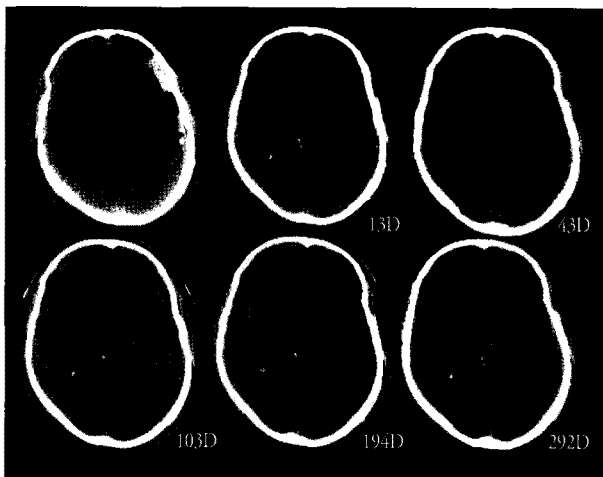


Fig. 3. An example of a late resolution. The hematoma is remained till 292 days after surgery.

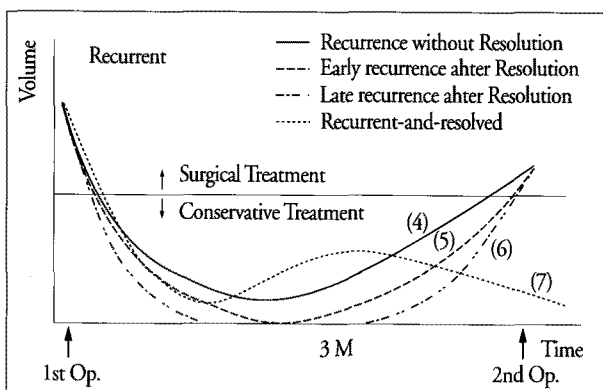


Fig. 4. Postoperative courses of the recurrent chronic subdural hematoma. Recurrence without resolution is defined as increased volume of the hematoma without resolution (4). Early recurrence after resolution is defined as recurrence of the resolved hematoma within 3 months after surgery (5). Late recurrence after resolution is defined as recurrence of the resolved hematoma after 3 months or more (6). Finally, the recurrent-and-resolved type, which is the spontaneously resolved recurrent CSDH (7).

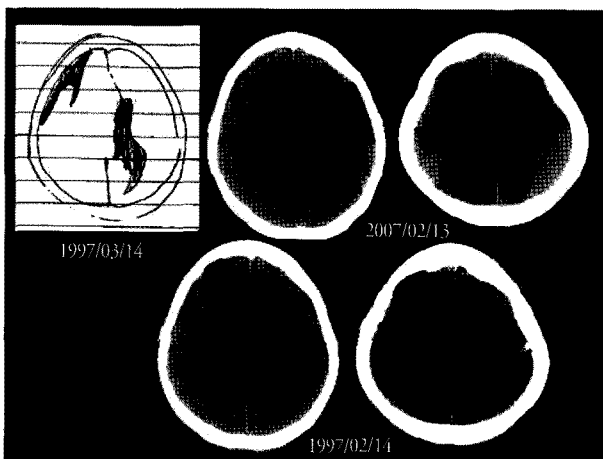


Fig. 5. The case 18 had a history of chronic subdural hematoma on the right frontal region in March 1997. She was suffered from the schizophrenia for more than 10 years. Chronic subdural hematomas were found on both sides in February 2007. She recovered from the chronic subdural hematoma by bilateral burr holes.

RESULTS

Postoperative courses

The CSDH was resolved within 30 days after surgery in 58 (39%) patients, between 1 to 3 months in 62 (42%), and after 3 months in 11 (7%) patients. The CSDH was recurred in 18 (12%) patients. Late resolution or recurrence was more common in the aged (Table 2). This difference was statistically significant ($p = 0.033$).

According to the laterality of the CSDH, delayed resolution was more common in the bilateral or right CSDHs (Table 3). Late resolution was also more common in the bilateral CSDHs. The recurrence rate was 16% in the left CSDH, while it was 8% in either the right or bilateral CSDHs. However, this difference is not statistically significant ($p = 0.464$).

Recurrence

The CSDH was recurred in 18 patients (Table 4). The recurrent hematoma was on the same side in 11 patients, on the different side in 7 patients. The hematoma was recurred within 3 months in 14 patients, usually without complete resolution (Type 4). Recurrence without resolution (Type 4) was observed in 8 patients. Early recurrence after resolution (Type 5) was observed in only 1 patient. Late recurrence after resolution (Type 6) was found in 3 patients. In 3 patients, the hematoma recurred on more than a year after the surgery. The longest interval from the first operation to the diagnosis of the recurrence was about 10 years in case 18. In this case, we could confirm the episode of CSDH in her medical record (Fig. 5). We operated again for the recurrent hematomas in 11 patients. In 7 patients, the recurrent hematomas were resolved spontaneously, i.e. the recurrent-and-resolved type (Type 7). Hematoma was found in the case 3 and case 16.

Recurrence was significantly ($p = 0.033$) more common in the thick (more than 20 mm) hematomas (Table 3). Although the recurrence rate was relatively high in the hematomas with severe (more than 10 mm) midline shift (Table 3), this difference is not statistically significant ($p = 0.675$).

DISCUSSION

The postoperative courses of CSDH were either resolved or recurrent. We proposed seven different postoperative courses of the CSDH. Early or delayed resolution (Type 1 & 2) was the most common postoperative courses of the CSDH. As criteria of the recurrence, some proposed the time interval, such as within 3 months^{1,13,23} or 6 months of the initial surgery¹⁸. Pathologically, CSDH is defined as liquefied hematomas accumulated within the so-called subdural space surrounded by the outer and inner membranes¹². If the

CSDH remained till one month after the drainage, the lesion is a liquefied hematoma encapsulated by membranes. Although the hematoma is clinically corresponding to the incomplete removal, it is a CSDH in pathologic term. Strict differentiation between reaccumulation and incomplete

removal is very difficult to deal together¹⁷⁾. More than a half of the recurrent CSDHs recurred within 30 days, and 70% of them recurred within 3 months. However, follow up for at least 2 months after surgery¹¹⁾ is not enough to check recurrence, since more than one third of recurrences were diagnos-

Table 2. Clinical features and postoperative courses of the chronic subdural hematoma

Clinical Features	Early Resolution	Delayed Resolution	Late Resolution	Recurred	Statistics
Age (yr)					$p = 0.033$
- 49	12	7	0	1	Fisher's test
50 - 69	28	24	4	6	
70 -	18	31	7	11	
Drainage					$p = 0.192$
- 1 day	17	25	4	10	chi-square test
over 1 day	41	37	7	8	
Subtotal (%)	58 (39)	62 (42)	11 (7)	18 (12)	

For the statistical comparison, we used the late resolution and the recurred as one group

Table 3. Radiologic features and postoperative courses of the chronic subdural hematoma

Radiologic Features	Early Resolution	Delayed Resolution	Late Resolution	Recurred	Statistics
Laterality					$p = 0.464$
Right	19 (40)	22 (46)	3 (6)	4 (8)	chi-square test
Left	32 (42)	28 (37)	4 (5)	12 (16)	
Bilateral	7 (28)	12 (48)	4 (16)	2 (8)	
Thickness*					$p = 0.033$
- 20 mm	27 (38)	35 (49)	4 (6)	5 (7)	chi-square test
> 20 mm	24 (45)	15 (28)	3 (6)	11 (21)	
Midline Shift*					$p = 0.675$
- 5 mm	15 (42)	12 (33)	5 (14)	4 (11)	chi-square test
5 - 10 mm	19 (41)	21 (46)	1 (2)	5 (11)	
> 10 mm	17 (40)	17 (17)	1 (2)	7 (17)	

For the statistical comparison, we used the late resolution and the recurred as one group. *except bilateral hematomas

Table 4. Clinical features of the recurrent chronic subdural hematomas

Case No.	Age	Sex	1st lesion	1st GCS	1st Tx	Drain	2nd lesion	2nd Tx	Interval (days)	Type
1	69	M	Lt	15	1bh	1	Lt	1bh	9	4
2	59	M	Lt	15	1bh	2	Rt	1bh	10	4
3	66	F	Lt	9	1bh	2	Lt	1bh	13	4
4	77	M	Rt	15	1bh	1	Rt	1bh	18	4
5	40	M	Lt	15	1bh	1	Lt	1bh	20	4
6	85	F	Lt	15	1bh	1	Rt	1bh	22	4
7	81	M	Lt	13	2bh	1	Lt	cons	26	7
8	72	M	B	15	bbh	1	B	cons	30	7
9	64	M	Rt	15	1bh	2	B	cons	34	4
10	74	M	Rt	14	1bh	1	Rt	1bh	36	4
11	72	M	Lt	15	1bh	2	Lt	cons	42	7
12	72	M	B	15	1bh	2	Lt	cons	61	7
13	70	M	Lt	15	1bh	1	Lt	cons	72	7
14	68	M	Lt	15	1bh	1	Lt	cons	78	7
15	86	M	Lt	15	1bh	2	Lt	1bh	114	5
16	74	M	Lt	12	1bh	2	Rt	1bh	599	6
17	82	M	Rt	13	1bh	2	Lt	1bh	3 yrs	6
18	44	F	Rt	15	1bh	1	B	bbh	10 yrs	6

GCS : Glasgow Coma Score, Tx : treatment, Interval : interval from the 1st operation to the diagnosis of the recurrence, Type : type of recurrence, see Fig. 4. Lt : left, Rt : right, bh : burr hole, bbh : bilateral burr holes, cons : conservative

ed after 2 months in this study.

The recurrent hematoma was on the same side in 11 patients, on the different side in 7 patients. Recurrence, based on medical dictionary, is defined as the return of symptoms after a remission. If the same pathologic lesion reappears after surgical removal, we can use the term recurrence regardless of the interval. Although someone may insist the term reaccumulation of the hematoma on the previously operated side, the reappearance of cancer cells in another location is also a recurrence. In the case 18, the second lesion was pathologically CSDH, the same pathology of the initial lesion, although the interval was about 10 years. To diagnose the recurrence, Torihashi et al.¹⁹⁾ required another operation after the initial surgery. However, repeated operations can be done for the incompletely removed hematomas. Spontaneous resolution of CSDH occurs by maturation of the neomembrane and stabilization of the neovasculature⁸⁾. Steroid therapy is a feasible and safe option in the management of CSDH, which was able to cure or improve two thirds of the patients with CSDH⁴⁾. In such cases, another operation is not necessary. After removal of a large unilateral CSDH with marked midline-shift, a small subdural hygromas may result on both sides, which became a recurrent bilateral CSDH. Even if we don't remove the hematoma surgically, the lesion is pathologically CSDH, which would be composed of liquefied hematoma within the inner and outer membranes. A repeated operation is not necessary to diagnose the recurrent CSDH.

The resolution was faster in relatively younger patients in this study. The resolution of the CSDH after burr hole drainage depends on the rate of cerebral re-expansion. The re-expansion rate was relatively low in patients who were 70 years old or more than that of patients who were less than 70 years old¹¹⁾. This is the reason why late resolution or recurrence was more common in the aged. Not only the age, pre-existing cerebral infarction, and air in the subdural space after surgery were thought to be the factors affecting re-expansion of the brain after surgery. Although there was a report that bilateral CSDH was an independent risk factor for the recurrence of CSDH¹⁹⁾, the recurrence rate of the bilateral CSDHs was not higher than the unilateral hematomas in this study. Theoretically, patients with bilateral CSDH tend to have previous brain atrophy, which may lead to poor brain re-expansion. However, expansion of the CSDH from the bilateral subdural hygroma is not always equal in both sides. This hemispheric pressure difference may result from premorbid brain status or head tilting. Expansion of the CSDH in one side abolishes the opposite lesion, which changes bilateral lesions into unilateral lesions⁹⁾. At this time, thickness of the hematoma becomes more important to the bilaterality itself. The recurrence rate was significantly high in the thick CSDHs in

this study. Some¹⁰⁾ reported that the thickness was a risk factor for the recurrence, while others¹⁹⁾ reported that the bilaterality was a risk factor for the recurrence. Many risk factors for recurrence of CSDH have been reported, including old age, cerebral atrophy, large hematoma, bilateral hematomas, hematoma density, inflammation markers, alcohol ingestion, bleeding tendency, and some technical aspects of surgery^{3,5,6,11,13,14,23)}. Recently, an upright posture after surgery was reported as a risk factor of CSDH recurrence¹⁾. Majority of these risk factors are related to the poor brain re-expansion.

Although grouping such as early, delayed and late according to the time interval is arbitrary, we have to differentiate the recurrence from the incomplete removal at least clinically. Because 70% of the recurrence occurred within 3 months, it seems reasonable to use the term early recurrence when there is a return of symptoms or reaccumulation of the hematoma after a surgery within 3 months, regardless of the second operation. Persistent CSDH beyond 3 months after surgery can be regarded as a late recurrence regardless of the location, amount or repeated operations.

CONCLUSION

For working criteria of the recurrence of CSDH, we propose the early recurrence as return of symptoms or reaccumulation of the hematoma after a surgery within 3 months regardless of the location, amount or repeated operations. The late recurrence can be defined as reappearance or enlargement of a liquefied hematoma within the cranial cavity surrounded by the membranes or persistent CSDH beyond 3 months after surgery.

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