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Retrospective Analysis of 14 Cases of Spinal Epidural Hematoma

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Objective: Spinal epidural hematoma (SEH) is rare diseases and they may have various causes. We reviewed our clinical experiences and analyzed the various factors related to the outcome for SEH. **Methods**: We investigated 14 patients (8 men and 6 women) who underwent hematoma removal for SEH from January 2003 to December 2010. We investigated age, gender, hypertension, anticoagulant use, radiographic finding such as the degree of cord compression and the extent and location of the hematoma and relationship between preoperative neurologic status, surgical timing and neurological outcome using the Japanese Orthopaedic Association (JOA) score by examining medical records. **Results**: In ten cases (71.4%) of operated 14 cases, there were post-operative improvements (recovery scale >50%) in clinical symptoms. We performed operation within 12 hour for seven cases, and the average of recovery scale for these cases was 69.9%. Six (85.7%) of these cases improved more than 50% on the recovery scale. There were seven cases that we performed operations on that were beyond 12 hour, and the average of the recovery scale was 47.7%. The average of the recovery scale in cases of incomplete injury after the operation was 64.4%, and the average of the recovery scale was 38.1% in cases of complete injury. There was a significant difference between two groups ($p<0.05$). **Conclusion**: Our present study demonstrates that surgical time interval and preoperative neurological status correlated with neurological recovery. The rapidity of surgical intervention and preoperative favorable neurological status maximize neurological recovery. (J Korean Neurotraumatol Soc 2011;7:51-56)

KEY WORDS: Traumatic subdural hygroma · Chronic subdural hematoma · Head injuries · Old ages.

Introduction

The clinical importance of spinal epidural hematoma (SEH) is due to its acute and progressive course that can lead to permanent neurological deficits if not treated properly. Although the incidence of SEH may be relatively low, it is important for clinicians to recognize the signs and symptoms of this disorder in a timely fashion to avoid the serious clinical consequences. Jackson[9] was the first to describe it in 1869 and since then approximately 275 cases have been reported in the literature.[8,15] SEH can occur secondarily by trauma, coagulopathy, spinal arteriovenous malformation, tumors, lumbar puncture, and idiopathic.[4,14,19] In the majority of cases, the clinical picture is characterized by the acute onset of back or neck pain, followed by rapidly progressive sensory and/or motor deficit. Sometimes, diagnosis and treatment may be delayed due to its vague clinical symptoms. Although, rapid surgical decompression and evacuation of the hematoma is the mainstay of treatment, controversy exists between those who advocate emergency surgery and those who operate on an urgent rather than emergency basis. McQuarrie[16] reported that delay before surgery reduced the probability of recovery. Foo and Rossier[5] reviewed the clinical literature and concluded that recovery did not depend on the timing of surgery but rather on the preoperative neurological condition of the patient, with better results in those with incomplete motor and sensory loss.

We reviewed our experience with patients with SEH who were surgically treated and analyzed relationship among preoperative neurological status, the operative time interval, and neurological outcome after surgery for SEH.

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Materials and Methods

Fourteen SEH were surgically treated from January 2003 to December 2010 and a retrospective analysis of 14 cases of SHE was performed. In fourteen patients, the mean age was 50.2 years (18−73). There were 8 male and 6 female patients. In this study, based on medical records, the past history of patient, pre-operative and post-operative symptoms, neurological test, simple X-ray, and magnetic resonance imaging were analyzed. The hematoma was assessed at the vertebral level on the sagittal MRI image. The degree of cord compression was measured as the maximal diameter of hematoma in relation to the diameter of spinal canal. The location of hematoma was classified as cervical, cervicothoracic, thoracic, thoracolumbar and lumbar regions on the sagittal MRI image. The position of the hematoma was also classified as dorsal, ventral and posterolateral on the axial MRI image. In our series, we included trauma, anti-platelet agents prior to surgery, hypertension, and other causes that hematoma could be developed spontaneously. As the analysis of neurological recovery factors after surgery, the time interval from the development of neurological deficit to decompression surgery was measured, the level of neurological status prior to surgery and post-operative neurological changes were recorded as the Japanese Orthopaedic Association (JOA) score.[18] The neurologic recovery rate was calculated as follows: (postoperative JOA score - preoperative JOA score)/(full score-preoperative JOA score) ×100. Neurological recovery rate was ranked as excellent (75−100%), good (50−74%), fair (25−49%), poor (0−24%), or worse (<0%). As surgical methods, all patients underwent operation via posterior approach. Laminectomy and the removal of hematoma were performed and if needed, posterolateral fusion was performed.

The data of neurologic recovery rate was analyzed using Wilcoxon signed rank test. Correlation of variables was analyzed statistically by using Spearman rank correlation coefficients (one-tailed test) and regression analysis with SPSS. p values <0.05 were considered significant.

Results

The general characteristic of the patient group

Fourteen patients were treated surgically. The Patient-characteristics are specified in Table 1. All patients had motor weakness that was accompanied with pain due to the compression of the spine by hematoma, neurological change of motor & sensory nerve were accompanied, and five patients (35.7%) accompanied urinary difficulty. Four patients presented with complete motor and sensory loss, one patient had complete motor loss but some sensation, and nine patients had incomplete loss of motor function. In the past history, five patients (46.1%) developed hematoma after trauma without spinal fracture and idiopathic patients were 3 cases (21.4%) and two (21.4%) patients who used the anti-coagulant coumadin medication. Patients with SEH accompanying angiolipoma were 2 cases, post-operative SEH after lumbar microdiscectomy was 1 case and one patient developed SEH after receiving extracor-

TABLE 1. The characteristic of SSEH in 14 patients

	Sex	Age	Neurology	Lesion	Etiology	Initial JOA	Pre-op JOA	Interval (hour)	Compression degree %	Recovery scale (%)
1	M	18	SM incompl	C2-3	Trauma	15	17	11	37.6	100
2	F	21	SM incompl	C3-5	Trauma	13	15	8	42.1	50
3	M	18	SM incompl	C2-D4	Angiolipoma	12	14	26	56.4	40
4	M	69	SM compl	C3-D4	Anticoagulant	0	4	8	78.6	36.3
5	F	52	SM incompl	T1-6	Angiolipoma	5	8	16	58.6	50
6	F	67	SM compl	T9-12	Idiopathic	0	3	15	62.5	27.2
7	M	61	SM incompl	T10-12	ESWL	6	10	13	38	80
8	F	73	SM compl	T11-12	Idiopathic	0	7	9	64.1	63.6
9	M	43	SM incompl	T11-12	Trauma	7	9	15	58.8	50
10	M	52	SM compl	L1-5	Idiopathic	0	6	4	57.3	55.5
11	F	54	SM incompl	L1-5	Anticoagulant	7	10	8	76.9	75
12	M	23	SM incompl	L4-5	Trauma	7	9	36	72.1	50
13	F	27	SM incompl	L1-4	Postop. Cx	5	11	8	59	100
14	M	30	SM incompl	L4-S1	Trauma	6	9	15	68.1	60

ESWL: extracorporeal shock wave lithotripsy, S: sensory, M: motor, comp: complete, incompl: incomplete, Postop. Cx: postoperative complication, JOA: Japanese Orthopaedic Association

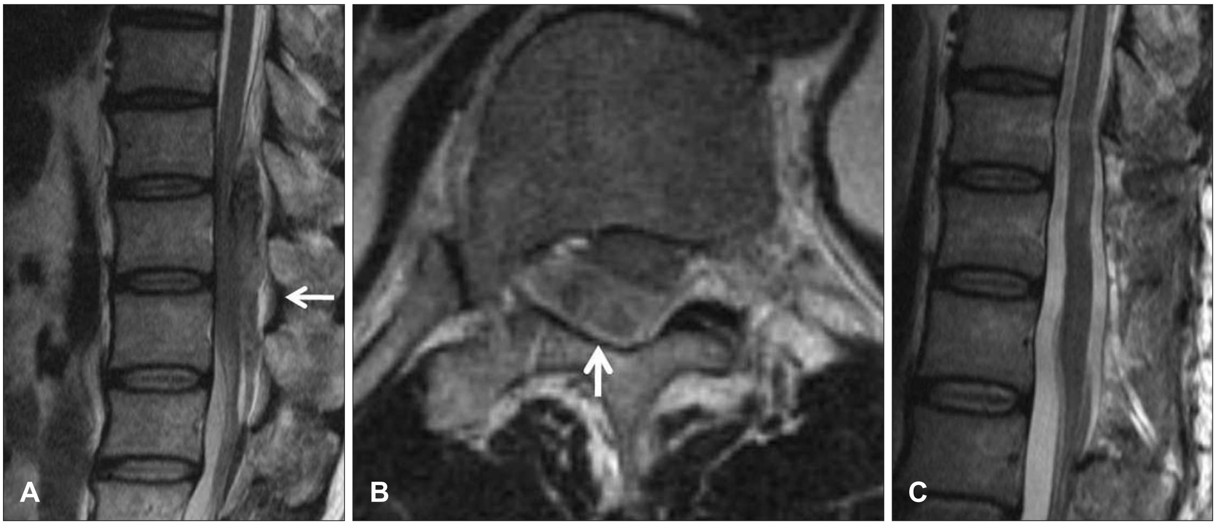

FIGURE 1. Preoperative and Postoperative MRI of 61 year-old male patient (case 7). He visited to emergency room with lower extremities weakness and voiding difficulty after ESWL treatment for urolithiasis. Sagittal T2- (A) and axial T2-weighted (B) magnetic resonance images of an acute epidural hematoma with maximal compression at the T10-12 level (arrows). T10-L1 total laminectomy was performed. Postoperative sagittal T2-weighted (C) magnetic resonance images show no cord compression. ESWL: extracorporeal shock wave lithotripsy.

poreal shock wave lithotripsy (ESWL) for urolithiasis (Figure 1). The hematomas of 14 patients invaded more than two vertebral levels. The extent of hematoma was distributed from two to fifteen vertebral segments, its average was 4.1 vertebral levels. There were three cervical hematomas, two cervicothoracic hematomas, five thoracic hematomas and four lumbar hematomas. Twelve cases were dorsal hematomas, and 1 case was a posterolateral hemtoma. The degree of compression by the hematoma was from 37.6% to 78.6%, and the average compression was 59.3%. As surgical treatments, all patients underwent posterior approach with laminectomy and hematoma removal and if needed, posterior fusion was performed. There was no complication related to the surgical operations.

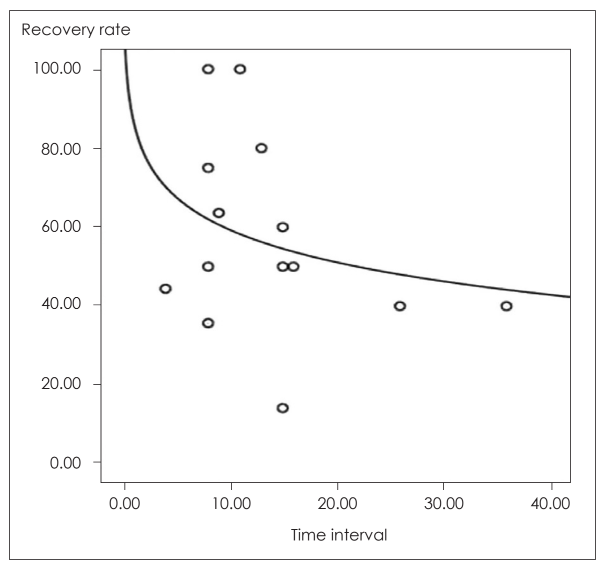

FIGURE 2. The relationship between surgical timing and neurological outcome. Outcome correlates inversely with the time interval from symptom onset to surgery (Spearman rank correlation coefficient=-0.68, $p<0.05$).

Neurological results

The neurological abnormal findings of patients corresponded to the area where spinal cord compression was detected by magnetic resonance imaging. For the operative time interval, the period from symptom onset to the operation was from 4 hour to 36 hour, and the average was 13.7 hour. We performed operation within 12 hours for seven cases, and the average of recovery scale for these cases was 69.9%. Two patients returned to a normal condition, one patient showed excellent outcome, three patients with good outcome and one patient with fair outcome. Six (85.7%) of these cases improved more than 50% on the recovery scale. There were seven cases that we performed operations on that were beyond 12 hour, one patient showed excellent outcome, three patients with good outcome, two patients with fair outcome and one patient with poor outcome. There was no patient return to normal condition. The average of the recovery scale was 47.7%. Four (57.1%) of them improved more than 50%. The shorter the operative time interval, the more improvement in the recovery scale, particularly within 12 hour ($p<0.05$). There was an inverse correlation between the operative time interval and recovery scale (Spearman rank correlation coefficient=−0.68, $p<0.05$)(Figure 2). The average of the recovery scale in cases of incomplete injury after the operation was 64.4%, and in cases of complete injury the average of the recovery scale was 38.1% ($p<0.05$). There was a statistically significant difference between the complete and incomplete neurological injury on the preoperative neurological status (Table 2).

Among 10 patients with incomplete injury, four patients underwent surgical treatment within 12 hours and the average of recovery scale was 81.2%. The other patients were treated beyond 12 hours and the average of recovery scale was 53.3%. In cases of incomplete injury, there was a statistically significant difference between the patients who were operated on within 12 hour (four cases) and those patients (six cases) who were operated on after 12 hour ($p<0.05$). In 4 patients with complete injury, the average recovery scale of three patients who underwent surgery within 12 hour was 51.6% and that of the other patient was 14.7%. Because of small number of cases, we can't clarify the statistical difference between two groups. There was no correlation between postoperative outcome and age, gender, hematoma location, the extent of the hematoma and the degree of cord compression owing to hematoma.

Discussion

There are many causes for SEH, including trauma, the use of anticoagulant after valvuloplasty, therapeutic thrombolysis in acute myocardial infarction, hemophilia patients, long term intake of antiplatelet agent, spinal vascular malformation (spinal AVM), etc. have been suggested.[12,17,20,21,23)]

Spine surgery, epidural catheterization, and anticoagulation therapy accounted for 73% of the hematomas. The exact incidence of this complication with these various therapeutic interventions is difficult to ascertain. However, we guess that the incidence of postoperative SEH may be exceedingly low. In our experience, about 400 hundred spine surgery were performed annually during a 14-year period at our institution, we experienced only one postoperative SEH patient (case 13) after lumbar microdiscectomy. Among SEH patients, the incidence of spontaneous SEH has been reported to 40−50% of them.[2,13)] The most common causative of spontaneous SEH has been reported to be idiopathic (60%), and as the next common causative, blood coagulation impairment (20−30%) has been reported.[22,23)] In our study, the most prevalent cause was trauma in 5 patients (35.7%), idiopathic patients were 3 patients (21.4%), angiolipoma were 2 patients (14.2%), patients used anti-coagulants were 2 cases (14.2%), 1 case was postoperative complication and 1 patient was related to ESWL treatment .

Up to now, the time interval of spinal cord decompression for patients with SEH has long been a controversial topic. Foo et al.[5)] have reported that the spent time interval from the development of neurological deficit to decompression surgery was not associated with prognosis. Alexiadou-Rudolf[1)] have reported that in cases performed surgery within 12 hours after the development of symptoms, neurological improvement was shown and in Markham[15)] reported that in cases performed surgery within 24 hours, 50% of patients showed neurological improvement. Our findings are consistent with other clinical reports describing this relationship.[1,5,15)] As for our experience, good outcomes were found when the patients were operated on within 12 hour. Especially, among 10 patients with incomplete injury, four patients were operated within 12 hour, all patients showed good outcomes, two patients returned to a normal condition who underwent surgical treatment within 12 hours. In contrast, failure to return to normal condition was observed with complete injury even if surgical decompression done within 12 hour. That is, the patient made a complete recovery by means of the rapid surgical decompression that was done less than 12 hour before the neurological status completely deteriorated. Although the preoperative neurological status strongly predicts the neurological outcome, surgery has to be performed within at least 12 hour for the patients with a poor neurological status because the patients showed good outcome in those cases of surgical decompression that were done in less than 12 hour. In our study, there was an inverse correlation between time interval and recovery scale (Figure 2). If neurological deficit were developed in spinal cord compression, surgical decompression is required as soon as possible.

Several investigators reported that the level of pre-operative neurological deficit is the most important factor.[5,6,11,14)] In cases with severe pre-operative neurological deficit, post-operative prognosis was poor, and it was interpreted that in cases with severe pre-operative neurological deficit,

TABLE 2. Improvement in recovery scale (n=14; values are mean±SD)

Neurological status	JOA score initial	JOA score after operation	Recovery scale
Incomplete (10)	7.9±2.3	13.2±1.8	64.4%*
Complete (4)	0	5.2±2.8	38.1%

*$p<0.05$ (significant difference between the complete and incomplete neurological injury after operation). JOA: Japanese Orthopaedic Association

hematoma was formed in the epidural space within a short time, and spinal cord & nerve roots did not have a sufficient time to adjust to such sudden compression by hematoma, and thus prognosis is poor even after surgical treatments. On the other hand, it is thought that in cases that hemorrhage progresses slowly or hematoma is developed spreading in a wide area, spinal cord and nerve roots have a sufficient time to adjust to the change of hematoma pressure, and thus post-operative prognosis is relatively good.[3,7] In our cases, the good recovery were showed in all patients among the incomplete deficit patients who were treated surgically within 12 hour, but none of the complete deficit patients returned to normal and only one patient showed good recovery. We think that the preoperative neurological status is important factor to affect the neurological outcome after the surgical operation. Nevertheless, two patients with complete neurological deficit who were surgically treated within 12 hours improved more than 50% after their surgical operation. Although it did not reach statistical significance, we assume that emergent evacuation of hemorrhage within 12 hours may give the patient the best opportunity for optimal recovery in the face of complete deficits. The neurological outcome was better for patients with incomplete injury status after the surgical operation than those with complete injury status ($p<0.05$). Moreover, there was a meaningful statistical difference between the JOA score before the operation and the recovery scale after the operation ($p<0.05$) in patients with incomplete injury. We summarized that the better preoperative JOA score leads to the better postoperative JOA score (Figure 3).

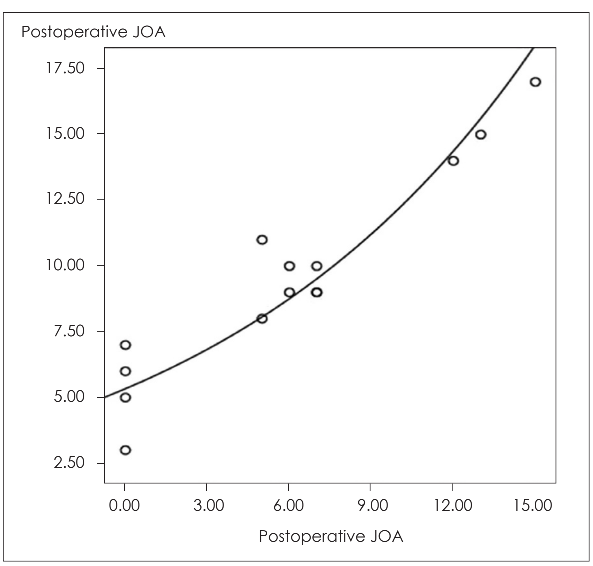

FIGURE 3. The relationship between pre-operative neurological status and post-operative outcome. The postoperative surgical results are correlated with pre-operative neurological status. (Spearman rank correlation coefficient=0.8, $p<0.05$). JOA: Japanese Orthopaedic Association.

Conclusion

SEH is a rare disease entity but a disabling surgical disorder. Surgical decompression is beneficial to relieve cord compression and reverse the neurological deficits. Preoperative incomplete neurological deficits and rapid surgical treatment remain predictive of good surgical outcome. We treated our patients with surgical operation and achieved favorable outcomes. Evacuation of SEH as early as possible to prevent irreversible damage to the cord is highly recommended in patients whose deficits remain incomplete. In the face of complete deficits, emergent evacuation of hemorrhage within 12 hours may give the patient the best opportunity for optimal recovery.

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