Incidence of postoperative symptomatic epidural hematoma in spinal decompression surgery

Clinical article

HIROYUKI AONO, M.D., PH.D.,1 TETSUO OHWADA, M.D.,2 NOBORU HOSONO, M.D., PH.D.,3 HIDEKAZU TORIMATSU, M.D.,1 KEN I WAKA ARIGA, M.D., PH.D.,4 TAKESHI FUJI, M.D., PH.D.,3 AND MOTOKI IWASAKI, M.D., PH.D.4

Departments of Orthopaedic Surgery, 1Osaka National Hospital, Osaka; 2Kansai Rosai Hospital, Hyogo; 3Osaka Koseinenkin Hospital, Osaka; and 4Osaka University Graduate School of Medicine, Osaka, Japan

Object. Neurological deterioration due to spinal epidural hematoma (SEH) is a rare but significant complication of spinal surgery. The frequency of hematoma evacuation after spinal surgery is reportedly 0.1%–3%. The objective of this study was to investigate the symptomatology of SEH and the frequency of evacuation for each surgical procedure after spinal decompression surgery.

Methods. This is a retrospective study of 26 patients who underwent SEH evacuation after spinal decompression surgery between 1986 and 2005. During this period, 6356 spinal decompression surgeries were performed. The factors studied were the frequency of SEH evacuation for each surgical procedure, symptoms, time to SEH evacuation, comorbidities, and neurological recovery.

Results. The frequency of SEH evacuation was 0.41% (26 of 6356) for all operations. The frequency for each surgical procedure was 0% (0 of 1568) in standard lumbar discectomy, 0.50% (8 of 1614) in lumbar laminectomy, 0.67% (8 of 1191) in posterior lumbar interbody fusion, 4.46% (5 of 112) in thoracic laminectomy, 0.44% (4 of 910) in cervical laminoplasty, and 0.21% (1 of 466) in cervical anterior spinal fusion. Nine patients had comorbidities involving hemorrhage. Spinal epidural hematoma evacuation was performed between 4 hours and 8 days after the initial operation. Whereas severe paralysis was observed within 24 hours in most patients undergoing cervical and/or thoracic surgery, half of the patients undergoing lumbar surgery had symptoms of SEH such as leg pain or bladder dysfunction after suction drain removal. The shorter the period to evacuation, the better were the results of neurological recovery.

Conclusions. Postoperative SEH was most frequent after thoracic laminectomy. In cervical and thoracic surgeries, symptoms of SEH were noted within 24 hours, mostly severe paralysis, and almost half of the lumbar surgery patients had symptoms after suction drain removal. (DOI: 10.3171/2011.3.SPINE10716)

Key Words • spinal epidural hematoma • incidence • spinal decompression surgery

Spinal epidural hematoma is a rare clinical entity. The origins of SEH include trauma, indwelling spinal catheters, anticoagulation therapy, lumbar puncture, blood dyscrasias, infections, vascular malformations, pregnancy, and spine surgery. Since SEH was first described by Jackson1 in 1869 there have been numerous reports on SEH. Although asymptomatic SEH has been identified by CT and MR imaging studies in 33% to 100% of patients who underwent lumbar disc or decompression surgery,2,6,10,15,18,22 most cases are asymptomatic and only in rare conditions does SEH become symptomatic. Once neurological deterioration due to SEH develops, emergency evacuation is required and if it is not performed rapidly enough, neurological sequelae such as paralysis may persist.

Recent reports have revealed risk factors for symptomatic SEH, including multilevel procedures, preoperative coagulopathy, preoperative nonsteroidal antiinflammatory drugs, large intraoperative blood loss volumes, advanced age, Rh-positive blood types, intraoperative hemoglobin values < 10 g/dl, and international normalized ratio values.1,9,11,22 However, no report has focused on the incidence of postoperative SEH for each surgical procedure. In the current study, we retrospectively examined postoperative SEH producing neurological deterioration and requiring evacuation after spinal decompression surgery. We also studied symptoms of SEH and the incidence of SEH evacuation for each surgical procedure.

Abbreviations used in this paper: MMT = manual muscle test; PLIF = posterior lumbar interbody fusion; SEH = spinal epidural hematoma.
Incidence of postoperative symptomatic epidural hematoma

Methods

Study Sample

We reviewed the surgical database providing details of all operations performed between 1986 and 2005 in Osaka Koseinenkin Hospital. This is a retrospective review of prospectively collected data. The research data were entered by spine surgeons who worked at that time, and was collected by the authors. The patients included in the current study had required hematoma evacuation and were given the ICD-10 code for a hematoma-complicating procedure. During the 20-year period, 6356 spinal surgeries were performed, including 1568 standard lumbar disectomies (with hemilateral laminectomy), 1614 lumbar laminectomies with/without discectomy (572 single-level, 1042 multilevel), 1191 PLIFs, 112 thoracic laminectomies, 910 cervical laminoplasties, 466 cervical anterior spinal fusions, and 495 other procedures (Table 1).

Operative Protocol

Postoperative closed-suction drains (polyvinyl chloride, round, drainage tube type; SB Vac) were used for all operations and were maintained for at least the first 24 hours for standard discectomy, single lumbar laminectomy, and anterior cervical spinal fusion, and for at least the first 48 hours for PLIF, multiple lumbar laminectomy, thoracic laminectomy, and cervical laminoplasty, and then removed. There were no standard protocols for drain removal. Some surgeons may remove the drain if output is < 50 ml per 12 hours while others may tolerate larger volumes. Anticoagulation therapy was stopped for all patients in accordance with the protocol provided by each drug manufacturer. For patients who required preoperative heparinization due to comorbidity, intravenous heparinization was discontinued 4–6 hours before the operation. Anticoagulation therapy was restarted approximately 1 week after the operation. Our indications for hematoma evacuation were paralysis in progress (MMT score < 3) and unbearable neurogenic (radicular) pain.

Outcome Variables

The outcome variables we studied were the frequency of SEH evacuation for each surgical procedure, symptoms of SEH, time between the appearance of symptoms and evacuation, comorbidity, and neurological recovery after evacuation. Regarding neurological recovery, patients had evacuation, comorbidity, and neurological recovery after evacuation, such as MR imaging and myelography, were performed in 18 patients, and all received a diagnosis of SEH. Spinal epidural hematoma compression of the thecal sac was identified intraoperatively in all 26 patients.

Statistical Analysis

The 95% CIs were calculated to assess the differences in frequencies of epidural hematoma evacuation among surgical procedures using the statistical program JMP version 5.0 (SAS Institute). A probability value < 0.05 was regarded as statistically significant.

Results

Of the 6356 patients, 26 (0.41%) met our study criteria. No patients had symptoms in the immediate postoperative period, and the shortest duration to symptom onset was 1 hour. Preoperative evaluations before SEH evacuation, such as MR imaging and myelography, were performed in 18 patients, and all received a diagnosis of SEH. Spinal epidural hematoma compression of the thecal sac was identified intraoperatively in all 26 patients.

Hematoma Evacuation

The incidence of hematoma evacuation for each surgical procedure was: 0% (0 of 1568) in standard lumbar discectomy, 0.50% (8 of 1614) in lumbar laminectomy (0.35% in single level, 0.58% in multilevel), 0.67% (8 of 1191) in PLIF, 4.46% (5 of 112) in thoracic laminectomy, 0.44% (4 of 910) in cervical laminoplasty, 0.21% (1 of 466) in cervical anterior spinal fusion, and 0% (0 of 495) in other procedures (Table 1). Thus, we had 10 patients with SEH at the spinal cord level and 16 with SEH at the cauda equina level. Furthermore, evacuation due to SEH was most frequent after thoracic laminectomy.

Statistical analysis yielded 95% CIs of 0.00–0.23 in standard discectomy, 0.12–0.97 in lumbar laminectomy (0.04–1.24 for single level, 0.21–1.25 for multilevel), 0.29–1.32 in PLIF, 1.47–10.11 in thoracic laminectomy, 0.12–1.12 in cervical laminoplasty, and 0.01–1.19 in cervical anterior spinal fusion. Thus, undergoing a thoracic laminectomy involved a significantly higher risk of hematoma evacuation than the other surgical procedures.

Comorbidities

Regarding comorbidity, 9 (35%) of the 26 patients had associated illnesses involving hemorrhage. This group included 3 patients receiving hemodialysis, 3 with thrombocytopenia (platelets < 100,000/μl) due to liver cirrhosis, and 3 receiving anticoagulation therapy. Hemodialysis was performed 1 day before the operation, and heparin was used for anticoagulation in all 3 cases. Platelets were transfused during the operation for all 3 patients with thrombocytopenia. The medications used for anticoagulation therapy were aspirin in 2 patients and ticlopidine hydrochloride in 1 patient. Both of these medications had been
discontinued before the operation. Symptoms of SEH were observed before restarting anticoagulation therapy. Peroperative prothrombin times were within normal range except in 1 patient receiving hemodialysis.

**Symptoms of SEH**

Symptoms of SEH at the spinal cord level (cervical and thoracic) manifested in 8 patients as flaccid paralysis. As flaccid paralysis was observed in all 5 patients who had undergone thoracic laminectomy as well as in the 3 undergoing cervical laminoplasty. No patients complained of radicular pain.

Symptoms of SEH at the cauda equina (lumbar) level manifested in 5 patients as paralysis without radicular pain, as both radicular pain and paralysis in 6, as unbearable radicular pain without apparent paralysis in 4, and as bladder dysfunction without radicular pain and paralysis in 1.

Evacuation of an SEH was performed within 4 hours and 8 days after the initial operation. Symptoms of SEH were observed within 24 hours (while the suction drain was still in place) after the initial surgery in 90% of patients (9 of 10) undergoing cervical and thoracic surgeries. In contrast, 44% of patients (7 of 16) who underwent lumbar surgery had symptoms of SEH after suction drain removal.

Examination of neurological recovery revealed that paralysis persisted in 4 patients. Among 20 patients who underwent SEH evacuation within 24 hours of the symptom onset, 19 experienced complete recoveries and 1 a partial recovery. Among the other 6 patients undergoing evacuation after 24 hours, 3 experienced complete recoveries, 2 partial recoveries, and 1 showed no recovery. The initial operations in these 6 patients were all lumbar procedures.

**Discussion**

Symptomatic postoperative SEH is a rare complication of spine surgery. However, it is a major complication of spinal decompression surgery and may be unavoidable in some cases. Due to its location adjacent to the dura and neural tissues, symptomatic SEH can result in serious morbidity if not controlled appropriately. Therefore, early detection of SEH is essential for preventing disastrous sequelae.

There are reports concerning SEH after spinal surgery, and the incidence of hematoma evacuation after spine surgery ranges from 0.1% to 0.2%. In these reports, the incidence of SEH evacuation was evaluated for all procedures together and a postoperative suction drain was not used in all patients. Operative time and estimated blood loss differ among surgical procedures, such that the incidences should be evaluated separately. However, no report has yet focused on the incidence of hematoma evacuation for each surgical procedure.

The clinical question of why evacuation was more frequent after posterior thoracic surgery should be considered. Spinal alignment may be one possibility. Because the thoracic spine has kyphotic alignment, the space between paravertebral muscles and the spinal cord is narrow compared with the cervical and lumbar spine, which has lordotic alignment. The space may be narrower due to edema of muscles after an operation and the narrow space may lead to compression of the spinal cord with a smaller hematoma.

We can offer another possible explanation of this greater frequency: spinal cord blood flow. Marcus et al. reported mean blood flow to the cervical and lumbosacral cord segments to be 40% higher than flow to the thoracic cord in dogs. Because vascularity of the canine spinal cord is similar to that of humans, we can apply these results from Marcus et al. to clinical cases. In humans, Dommisse identified the area from T-4 to approximately the T-9 vertebral level as having the least abundant blood supply and designated this area the “critical vascular zone” of the spinal cord, where interference with circulation was most likely to result in paraplegia. In the current study, 4 of 5 patients with SEH at the thoracic cord level had lesions that included this critical vascular zone. This observation appears to support our concept. Furthermore, a hypothesis has been proposed that ischemia subsequent to the spinal cord compression plays an important role in the pathogenesis of the spinal cord dysfunction, and there are references that support this hypothesis.

Postoperative delayed hematoma, which reflects neurological deterioration due to SEH observed after more than 3 postoperative days, was first described by Uribe et al., who reported the longest duration until symptom onset was 13 days after the initial surgery.

In the current study, there were 3 cases (0.05%) with delayed SEH, all after lumbar surgery, and the durations until symptom onset ranged from 4 to 7 days. Given that all cases with delayed hematoma had symptoms after suction drain removal, bleeding from the site of drain placement may have been the causative factor, although we have no clinical evidence to support this speculation.

Several authors have reported that use of suction drainage is not necessary for single-level lumbar decompression surgery, and the incidence of hematoma evacuation was 0%. Brown and Brookfield reported that either use or nonuse of a closed-suction drain did not result in a symptomatic hematoma, even in extensive lumbar spine surgery including multilevel decompression surgery and instrumentation surgery. On the other hand, in previous reports, multilevel procedures and excessive blood loss were risk factors for hematomas.

Scuderi et al. reported that hematoma evacuation was performed in 1 patient (1.25%) among 80 with single-level lumbar fusion and nonsegmental instrumentation at a single level without a closed-suction drain. In the current study, we used a postoperative closed-suction drain for all cases because there is no clear consensus regarding the use or nonuse of this drain.

Our study has several limitations. Only 26 patients underwent hematoma evacuation. We checked the surgical database of all 6356 patients, but clinical records were checked for only 26 patients who underwent hematoma evacuation. Therefore, we could not find risk factors of symptomatic hematoma nor did we evaluate the clinical
courses of patients with symptomatic hematoma who did not undergo hematoma evacuation.

Regarding the timing and indication of hematoma evacuation, our indications for hematoma evacuation were paralysis in progress (MMT < 3) and unbearable neurogenic (radicular) pain. Previous reports have described the incidences and risk factors of SEH, but there have been few reports describing the management of SEH. Therefore, surgeons generally hesitate to perform a hematoma evacuation. Sokolowski et al. reported that greater thecal sac compression by a hematoma resulted in more severe symptoms. Furthermore, Okuda et al. reported that in cases in which severe motor loss occurs a few days after lumbar arthrodesis, surgical intervention should be performed. Regardless of arthrodesis and/or instrumentation surgery, in cases with paralysis and MMT score < 3, we also recommend that evacuation be performed immediately to confirm decompression of nerve roots. In cases with slight paralysis (MMT score of 3 or 4 or slight pain), absorption of the hematoma may be expected. There were cases involving severe bowel and bladder dysfunction even with slight paralysis, therefore we have to observe bowel and bladder dysfunction carefully.

Conclusions

Postoperative SEH was most frequent after thoracic laminectomy. In cervical and thoracic surgeries, symptoms of hematoma were observed within 24 hours in lumbar surgery, usually as severe paralysis. Furthermore, almost half of the patients had developed symptoms of hematoma after suction drain removal. Delayed diagnosis and evacuation are associated with poorer recovery.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following. Conception and design: Aono, Tobimatsu. Acquisition of data: Aono. Analysis and interpretation of data: Aono. Drafting the article: Aono. Critically revising the article: Aono. Approved the final version of the paper on behalf of all authors: Aono. Study supervision: Ohwada, Hosono, Ariga, Fuji, Iwasaki.

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