Post-Operative Spinal Epidural Hematoma after Thoracic and Lumbar Spinous Process-Splitting Laminectomy for Thoracic and Lumbar Spinal Stenosis

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Abstract:

Introduction: To investigate the risk of epidural hematoma after spinous process-splitting laminectomy (SPSL).

Methods: A total of 137 cases (mean age, 72.4 years; 68 men) of SPSL were included. Of these, there were instances (3.7%; mean age, 70.5 years; all male) of postoperative development of new neurologic deficit due to epidural hematoma requiring reoperation. The 133 subjects (72.5 years; 64 men) with normal postoperative course were used as controls, and comparisons were made between both groups using chi-squared and Student’s \( t \)-tests. Regarding our investigation of risk factors for epidural hematoma, logistic regression was conducted with presence or absence of hematoma as our primary outcome variable, and age, gender, disease duration, number of laminectomies, which levels were decompressed, blood loss, length of case, drain output, coagulopathy, and whether or not there was an intraoperative dural tear were our explanatory variables.

Results: All cases of hematoma were single-level laminectomies; there was one case of T9-10 and 3 cases of L2-3. In our direct comparison of both groups (hematoma versus control), the proportion of men was significantly higher in the hematoma group (100% versus 48%, \( p < 0.05 \)); levels decompressed were also significantly higher (\( p < 0.05 \)) in the hematoma group, and drain outputs were significantly lower (113 mL versus 234 mL, \( p < 0.05 \)). From our logistic regression analysis, the levels were significantly higher (\( \chi^2 = 15, p = 0.0001 \)) and the drain outputs were smaller (\( \chi^2 = 4.6, p = 0.03 \)) in the hematoma group.

Conclusions: Single-level decompression higher than the L2-3 level and reduced drain output were risk factors for spinal epidural hematoma. With this method of spinous process suturing and reconstruction there is less decompression compared with more conventional methods; therefore, the effect of hematoma may be more pronounced at higher vertebral levels with reduced canal width, and drain failure may also occur with this limited space.

Keywords:
lumbar spinal stenosis, risk factors, spinal epidural hematoma, spinous process-splitting laminectomy

Spine Surg Relat Res 2019; 3(3): 244-248
dx.doi.org/10.22603/ssrr.2018-0086
gical technique, complications such as muscle atrophy and decreased lumbar strength due to extensive paraspinal muscle detachment, postoperative kyphosis, and intervertebral instability have been reported. Therefore, various techniques for lumbar spinal canal enlargement preserving the posterior supporting tissues have been devised including spinous process osteotomy\(^2\), fenestration\(^3\), and unilateral laminotomy for bilateral decompression\(^4\). Lumbar spinous process-splitting laminectomy (SPSL) is a minimally-invasive technique that can preserve the posterior supporting tissues including the paraspinal muscles and interspinous ligaments\(^5\).

Neurologic deficit due to epidural hematoma may occur as a complication following spine surgery. Nevertheless, there are few reports on the incidence of postoperative epidural hematoma following SPSL. Accordingly, the purpose of this study is to investigate the risk of epidural hematoma following SPSL.

**Materials and Methods**

Informed consent was obtained from all participants before the study began. The study protocol was approved by the ethical review committee.

A total of 137 cases (mean age, 72.4 years; 68 men) of lumbar SPSL conducted from April 2013 until November 2017 were included.

The patient exclusion criteria were as follows: 1) those who had previous lumbar spinal surgery and 2) those who had spinal tumors, infectious disease, or spinal trauma; 87 subjects underwent single-level decompression, 40 subjects underwent 2-level decompression, and 10 subjects underwent 3-level decompression. The levels decompressed were T9-10, T12-L1, and L1-2 once each, L2-3 for 23 cases, L3-4, and L4-5. Statistical analyzes were performed using Stat View software (version 5.0, SAS institute, Cary, NC). All data are expressed as mean ± standard deviation. A threshold of p < 0.05 was considered statistically significant.

**Results**

**Descriptive statistics for epidural hematoma patients**

Table 1 contains descriptive statistics for the four patients who experienced neurologic deficits due to postoperative epidural hematoma and required reoperation. The frequency of occurrence was 3.7% (4/137), all subjects were men, all were single-level decompressions, and the level of decompression was at L2-3 or higher for all (Table 1).

**Results of the statistical analysis**

For each item (SPSL group, control group, p-value), the results were as follows: age (70.5, 72.5, p = 0.672), gender (4 male [100%), 64 male [48.2%], p = 0.041), disease duration in months (17.3, 33.1, p = 0.344), number of laminecto-
The drain outputs were smaller ($\chi^2 = 4.6, p = 0.03$) in the hematoma group (Table 3).

From our logistic regression analysis, the levels of decompression were significantly higher ($\chi^2 = 15, p = 0.0001$) and the drain outputs were smaller ($\chi^2 = 4.6, p = 0.03$) in the hematoma group (Table 3).

**Case presentation**

The case is that of a 72-year-old man with a medical history of diabetes and taking coagulopathy medication (Apixaban) who presented with spinal stenosis at levels L2-3 (Table 1; Nb 3, Fig. 1A). He complained of bilateral thigh pain and intermittent claudication at 200 meters without weakness and urinary disorder. His preoperative JOA score was 30; the VAS score for leg pain was 20/29 (normal score, 29 points); the visual analogue scale (VAS; from 0 [no pain] to 100 [extreme amount of pain]) for low back pain was 30; the VAS score for leg pain was 129.5±75.8; the time of surgery was 129.5±75.8; the drain output was 113.5±115.2; and the coagulopathy was 1%-25%. For SPSL postoperative hematoma, Baghdadi et al. reported a frequency of 0.1% (25/15,562)\(^{12}\). Increased diastolic blood pressure, the use of gelfoam, and increased postoperative drain output led to increased risk\(^{17}\). Awad et al. reported a risk of epidural hematoma of 0.21% (32/14,932)\(^{11}\), demonstrating that the risk factors included use of NSAIDs (Non-Steroidal Anti-Inflammatory Drugs), Rh-positive blood, age $> 60$ years, and surgery involving six or more levels\(^{10}\). Kou et al. reported a risk of 0.1% (12/12,000), demonstrating that the risk factors included multilevel procedures and preoperative coagulopathy\(^7\). Amiri et al. reported a 0.22% (10/4,568) risk of spinal epidural hematoma, demonstrating that the risk factors included increased alcohol consumption, revision surgery, and multilevel surgery\(^{10}\). Aono et al. reported a risk spinal epidural hematoma of 0.41% (n = 6,535)\(^{10}\). In the aforementioned studies, the prevalence of epidural hematoma ranged from 0.1% to 0.4%\(^{10}\). For SPSL postoperative hematoma, Baghdadi et al. reported a 2.7% risk (1/37)\(^{11}\). The frequency in our study was 3.7% (4/113). This prevalence of SPSL postoperative hematoma ranged from 2.7% to 3.7% is about 10 times as frequent as reports from conventional spine surgery. In the present study concerning SPSL, single-level decompression above L2-3 and reduced drain output were risk factors for spinal epidural hematoma. At these higher levels, the effect of hematoma may be more pronounced as there is reduced hematoma stretching from L1 to L2. Lower extremity weakness and leg pain completely recovered 1 month following surgery.

**Discussion**

In the present study, there were four patients (3.7%) who had occurrence of spinal epidural hematoma after SPSL. The risk factors for spinal epidural hematoma included single-level laminectomy higher than the L2-3 level and reduced drain output. Regarding incidence and risk factors for epidural hematoma following spinal surgery, Kao et al. reported a frequency of 0.16% (25/15,562)\(^{12}\). Increased diastolic blood pressure, the use of gelfoam, and increased postoperative drain output led to increased risk\(^{17}\). The prevalence of epidural hematoma ranged from 0.1% to 0.4%\(^{10}\). For SPSL postoperative hematoma, Baghdadi et al. reported a 2.7% risk (1/37)\(^{11}\). The frequency in our study was 3.7% (4/113). This prevalence of SPSL postoperative hematoma ranged from 2.7% to 3.7% is about 10 times as frequent as reports from conventional spine surgery. In the present study concerning SPSL, single-level decompression above L2-3 and reduced drain output were risk factors for spinal epidural hematoma. At these higher levels, the effect of hematoma may be more pronounced as there is reduced}

Table 2.

|                    | Epidural hematoma | Control | $P$-value |
|--------------------|-------------------|---------|-----------|
| No. of patients    | 4                 | 133     |           |
| Age                | 70.5±11.0         | 72.5±9.5| 0.672     |
| Disease duration   | 17.3±15.6         | 33.1±0.2| 0.344     |
| Gender (No. [%] of Males) | 4 (100)      | 64 (48.1)| 0.041     |
| No. of laminectomies | 1±0             | 1.4±0.6 | 0.165     |
| Levels decompressed | 1.75±0.5         | 3.7±0.7 | 3.1×10$^{-7}$ |
| Blood loss         | 54±27.3           | 68.2±55.0| 0.609     |
| Time of surgery    | 129.5±75.8        | 88.1±40.7| 0.053     |
| Drain output       | 113.5±115.2       | 234.6±119.4| 0.048     |
| No. (%) of Coagulopathy | 1 (25)     | 12 (9) | 0.131     |
| No. (%) of Dural tear | 1 (25)          | 8 (6) | 0.284     |

Table 3.

|                    | $\chi^2$ | $P$-value |
|--------------------|---------|-----------|
| Age                | 3.472   | 0.0624    |
| Gender             | 4.5×10$^{-8}$ | 0.999   |
| Multilevel procedures | 5.2×10$^{-9}$ | 0.999   |
| Levels decompressed | 15.06  | 0.0001    |
| Blood loss         | 4.3×10$^{-7}$ | 0.999   |
| Drain output       | 4.577   | 0.0324    |
| Coagulopathy       | 8×10$^{-9}$ | 0.999   |
| Dural tear         | 2.6×10$^{-6}$ | 0.998   |

From our logistic regression analysis, the levels of decompression were significantly higher ($\chi^2 = 15, p = 0.0001$) and the drain outputs were smaller ($\chi^2 = 4.6, p = 0.03$) in the hematoma group (Table 3).
canal width, and drain failure may also occur with this limited space. Based on this, we would urge caution when performing this procedure at the level of L2-3 or above. One limitation of our study is that the number of cases is small, requiring confirmation of our findings in a larger population.

Conclusion

We investigated the risk of postoperative epidural hematoma in SPSL. Epidural hematoma occurred in 4 out of 137 cases, with a frequency of 3.7%. Single-level decompression above L2-3 and reduced drain output were risk factors. As this technique entails less decompression compared with conventional methods, special attention must be paid to levels superior to L2-3 with narrower canal and potentially poorer drainage potential.

Disclaimer: Sumihisa Orita is one of the Editors of Spine Surgery and Related Research and on the journal’s Editorial Committee. He was not involved in the editorial evaluation or decision to accept this article for publication at all.

Conflicts of Interest: The authors declare that there are no relevant conflicts of interest.

Author Contributions: Y. Eguchi: project development, data collection, manuscript writing; M. Suzuki: support of surgical treatment; T. Sato: data collection; H. Yamanaka: data collection; H. Tamai: data collection; T. Kobayashi: data collection; S. Orita: data collection; K. Abe: data collection; M. Norimoto: project development, data collection; T. Umimura: data collection; Y. Aoki: data collection; M. Koda: data collection; T. Furuya: data collection; J. Nakamura: data collection; T. Akazawa: data collection; K. Takahashi: scientific guarantor of this manuscript; S. Ohtori: scientific guarantor of this manuscript

Ethics and Consent to Participate: We declare that all protocols involving humans have been approved by the Shimoshizu National Hospital and have been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. We declare that all participants provided written informed consent before their inclusion in this study.

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