Postoperative retroperitoneal hematoma following transforaminal percutaneous endoscopic lumbar discectomy

Clinical article

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Object. The purpose of this study was to demonstrate the clinical characteristics of postoperative retroperitoneal hematoma (RPH) following transforaminal percutaneous endoscopic lumbar discectomy (PELD) and to discuss how to prevent the complication of unintended hemorrhage.

Methods. The medical records of 412 consecutive patients treated with transforaminal PELD between January 2005 and May 2007 were reviewed. A total of 4 patients (0.97%) experienced symptomatic postoperative RPH. The clinical outcomes were evaluated using the visual analog scale and the Oswestry Disability Index.

Results. The common symptom in all patients with a hematoma was inguinal pain. The mean hematoma volume was 527.9 ml (range 53.3–1274.1 ml). Two patients with massive diffuse-type RPHs compressing the intraabdominal structures required open hematoma evacuation performed by general surgeons, and the other 2 patients with small, localized RPHs of < 100 ml were treated conservatively. The mean follow-up period was 21.3 months (range 13–29 months). The mean visual analog scale score for radicular leg pain improved from 7.6 to 1.8 and that for back pain improved from 4.3 to 2. The mean Oswestry Disability Index improved from 58.8 to 9.1%. The preoperative symptoms improved after the second treatment without significant neurological sequelae in all patients.

Conclusions. Although transforaminal PELD is a minimally invasive and safe procedure, the possibility of RPH should be kept in mind. Adequate technical and anatomical considerations are important to avoid this unusual hemorrhagic complication, especially in the patient with underlying medical problems or previous operative scarring. A high index of suspicion and early detection is also important to avoid the progression of the hematoma.

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Key Words • retroperitoneal hematoma • lumbar artery • transforaminal percutaneous endoscopic lumbar discectomy • hemorrhagic complication

 **Abbreviations used in this paper: ICU = intensive care unit; ODI = Oswestry Disability Index; PELD = percutaneous endoscopic lumbar discectomy; RPH = retroperitoneal hematoma; VAS = visual analog score.**
Methods

Data Collection

Between January 2005 and May 2007, we treated 412 consecutive patients who suffered from lumbar disc herniation with transforaminal PELD. The inclusion criteria for the procedure were as follows: 1) unilateral radicular leg pain that was more severe than axial back pain; 2) lumbar soft-disc herniation demonstrated by both CT scanning and MR imaging correlating to the clinical presentation; and 3) failure of conservative management for ≥ 6 weeks. In contrast, cases with definite segmental instability, central osseous stenosis, calcified disc herniation, painless weakness, infection, and spinal fracture were excluded. Among the consecutive 412 patients, 4 experienced symptomatic postoperative RPH. In all patients, postoperative MR imaging and/or CT scanning were performed at the time of symptom appearance, and follow-up images were obtained within several days. The total hematoma volume was calculated as the sum of all cross-sectional areas of the hematoma using Ultravisual 2.5.0 software (Emageon). The clinical outcomes were evaluated using the VAS for pain intensity and the ODI for the functional status.

Surgical Procedure

All procedures were performed according to the standard transforaminal endoscopic selective discectomy technique after administration of a local anesthetic. The patient was positioned prone on a radiolucent table, with mild flexion of the back. A transforaminal approach was then performed with a typical skin entry point of 8–12 cm from the midline. An 18-gauge spinal needle was inserted into the disc through the foraminal window under fluoroscopic guidance. After insertion of the needle, intraoperative discography was performed using a mixture of 6 ml of contrast medium and 1 ml of indigo carmine. The pathological nucleus and anular fissure could then be stained for easy discrimination through the fluoroscope. After the affixation, a final bevel-ended working cannula was inserted near the disc herniation. Next, a 5.8 × 5.1-mm ellipsoidal endoscope with an eccentrically placed 2.7-mm working channel and 2 irrigation channels was inserted. A modulated forceps and a side firing holmium–yttrium aluminum garnet laser under clear endoscopic visualization.

Results

Four (0.97%) of the 412 patients experienced symptomatic RPH in the immediate postoperative period. The mean age of the 2 women and 2 men was 42.5 years (range 31–64 years). The treated level was L4–5 in 3 patients and L3–4 and L4–5 in 1. The mean time to clinical detection was 2.9 hours (range 0.5–4 hours) after a symptom-free period. Based on the clinical course and volume of hematoma, the cases were classified into 2 categories: more severe diffuse-type RPH (Cases 1 and 2) and milder localized-type RPH (Cases 3 and 4).

The common symptom in all patients was inguinal pain. Patients with diffuse-type RPH complained of severe flank pain and swelling as well as inguinal pain. One patient (Case 4) suffered from concurrent weakness in hip flexion and knee extension (Grade 3). When the patients presented with aggravation of their symptoms, MR imaging was performed to examine the cause of the unexpected pain or weakness. The mean hematoma volume was 527.9 ml (range 53.3–1274.1 ml).

Two patients with diffuse-type RPH of > 500 ml underwent open hematoma evacuation performed by general surgeons, and the remaining 2 patients with localized-type RPH of < 100 ml underwent conservative treatment with intensive monitoring. The mean hospital stay was 7.5 days (range 5–10 days). Three patients were discharged without any significant sequelae, and 1 patient (Case 4) was discharged with Grade 4 transient hip flexion weakness and mild dysesthesia on the lateral thigh, which improved within 6 months. The demographic findings are summarized in Table 1. The mean follow-up period was 21.3 months (range 13–29 months). The mean VAS score for radicular leg improved from 7.6 ± 0.8 to 1.8 ± 0.5 and that for back pain improved from 4.3 ± 0.9 to 2 ± 0.8. The mean ODI improved from 58.8 ± 7.8% to 9.1 ± 4.8%.

Summary of Cases

Case 1

Examination. This 64-year-old man was admitted with intractable left leg pain and numbness along the L-5 dermatome. The MR images and CT scans revealed a soft-disc extrusion at the L4–5 level (Fig. 1A). The pain

<table>
<thead>
<tr>
<th>No.</th>
<th>Age (yrs), Sex</th>
<th>Associated Problem</th>
<th>Levels</th>
<th>Time to RPH Onset (hrs)</th>
<th>Symptoms &amp; Signs</th>
<th>Withdrawal Bleeding</th>
<th>Vol of RPH (ml)</th>
<th>Type of RPH Treatment</th>
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<tr>
<td>1</td>
<td>64, M</td>
<td>Liver cirrhosis</td>
<td>L4–5</td>
<td>3</td>
<td>inguinal &amp; flank pain</td>
<td>yes</td>
<td>1274.1</td>
<td>diffuse evacuation</td>
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<td>2</td>
<td>31, F</td>
<td>Recurrent herniation</td>
<td>L4–5</td>
<td>4</td>
<td>inguinal &amp; flank pain</td>
<td>yes</td>
<td>704.0</td>
<td>diffuse evacuation</td>
</tr>
<tr>
<td>3</td>
<td>34, M</td>
<td>No</td>
<td>L4–5</td>
<td>4</td>
<td>inguinal &amp; buttock pain</td>
<td>no</td>
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<td>4</td>
<td>41, F</td>
<td>No</td>
<td>L3–4, L4–5</td>
<td>0.5</td>
<td>inguinal pain &amp; hip flexion weakness</td>
<td>no</td>
<td>53.3</td>
<td>localized conservative</td>
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</table>
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TABLE 2: Clinical outcome of second treatment for RPH

<table>
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<tr>
<th>Case No.</th>
<th>VAS Score Leg Preop</th>
<th>VAS Score Leg Post-op</th>
<th>VAS Score Back Preop</th>
<th>VAS Score Back Post-op</th>
<th>ODI (%) Preop</th>
<th>ODI (%) Post-op</th>
<th>Follow-Up Duration (mos)</th>
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<tr>
<td>1</td>
<td>8</td>
<td>2</td>
<td>5</td>
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<td>58</td>
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<td>29</td>
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<tr>
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<td>8.9</td>
<td>19</td>
</tr>
<tr>
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<td>8</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>64.5</td>
<td>15.6</td>
<td>13</td>
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</tbody>
</table>

did not respond to conservative treatments including epidural steroid injection. Rather, the patient’s radicular pain became more severe. Physical examination showed a 40° straight–leg raising limitation and Grade 4 muscle power with big toe in dorsiflexion. The patient suffered from liver cirrhosis (Child Class B). The preoperative blood values were as follows: glutamyl oxaloacetic transaminase/glutamyl pyruvic transaminase 49/43 IU/L, white blood cell count 1900 cells/µl, hemoglobin 13 g/dl, platelets 52,000/µl (normal range 130,000–400,000/µl), prothrombin time 75.2% (normal range 63–120%), activated partial thromboplastin time 29.1 seconds (normal range 29–36.8 seconds), and international normalized ratio 1.05 (normal range 0–1.15). Considering the patient’s general condition and the lumbar disc pathology, we decided to perform transforaminal PELD after administration of a local anesthetic.

Operation and Postoperative Course. The extruded disc was safely removed under endoscopic visualization. There appeared to be no more bleeding than usual except for mild blood oozing after removal of the working channel. The patient’s pain abated immediately after the procedure. Three hours later, however, the patient complained of severe pain in his right flank and groin, accompanied by local swelling. The patient’s blood pressure was 110/60 mm Hg, and his heart rate was 68 bpm. His blood profiles were as follows: hemoglobin 11.4 g/dl, platelets 55,000/µl, prothrombin time 61.5%, activated partial thromboplastin time 30.0 seconds, and international normalized ratio 1.19. Emergency MR imaging and CT scans were obtained and showed a massive RPH (1274.1 ml) shifting the intraabdominal structures to the opposite side (Fig. 1B and C). The patient was transferred to the intensive care unit ICU and received packed red blood cells and platelet concentrate as needed. After the blood profile and vital signs became stable, a careful open retroperitoneal exploration for hematoma debulking was performed by the general surgeons as the patient’s pain did not improve over time. Thereafter, the patient’s pain and discomfort abated again.

Postoperative Course. On the follow-up abdominal CT scan obtained 5 days later, there was no evidence of delayed bleeding. The patient was discharged on the 8th postoperative day without significant pain or neurological deficit.

Case 2

Examination. This 31-year-old woman had severe right radicular leg pain for 6 months. Radiological studies

![Fig. 1. Case 1. Axial MR image revealing left L4–5 disc herniation (A). Diffuse postoperative RPH can be seen (arrowheads) on T2-weighted axial (B) and sagittal (C) MR imaging.](image)
revealed a soft lumbar disc herniation at the L4–5 level (Fig. 2A). Physical examination revealed a 60° straight leg-raise limitation and L-5 dermatome sensory changes. The patient had no underlying medical problems, and the blood profile was within normal limits.

First Operation and Postoperative Course. Transforaminal PELD was performed in a routine manner. Her symptoms were relieved, and she was discharged with no radicular pain. Three weeks later, the leg pain returned and the patient visited our hospital again. Physical examination and radiological findings revealed a recurrent L4–5 disc herniation.

Second Operation and Postoperative Course. The patient underwent a repeated PELD via the same route. The extruded disc was removed safely, and there was no significant bleeding during the procedure. There was some blood oozing from the wound after taking out the working channel, and it was stopped with a 1-point suture. After the procedure, the radicular pain was greatly improved and the patient waited to be discharged. Four hours later, she suddenly complained of right groin and anterior thigh pain. Emergency MR imaging showed a diffuse RPH originating from extraforaminal area (Fig. 2B and C). The patient was transferred to the ICU.

Third Operation and Postoperative Course. After checking the patient’s vital sign and blood profiles, an emergency open paraspinal and retroperitoneal exploration was performed. The bleeding focus was a small terminal branch of segmental lumbar artery at the extraforaminal space and there was no active bleeding in the surgical field. Meticulous bleeding control and hematoma removal was performed. After the operation, the patient recovered without any neurological or vascular sequelae.

Case 3

Examination. This 34-year-old man suffered from back discomfort and intractable left leg pain for 8 months. Left lumbar disc herniation was diagnosed at the L4–5 level (Fig. 3A). He underwent repeated epidural blockades and exercise therapy for 2 months before visiting our hospital. Physical findings were a 50° straight leg-raise limitation and L-5 dermatome sensory disturbance. He had no underlying coagulopathy or other serious medical problems. Radiological findings showed soft lumbar disc herniation without lateral recess bony stenosis. Therefore, he underwent transforaminal PELD.

Operation. The herniated disc was easily removed, and the surgeon confirmed dural sac pulsation after the procedure. There was no evidence of active bleeding in an endoscopic overview. Four hours later, the patient felt left inguinal pain and anterior thigh discomfort. The pain was not relieved by usual painkillers. An MR image was obtained, and a left-sided RPH with localized psoas hematoma was seen (Fig. 3B). The hematoma was localized, and the total volume was measured to be 80.2 ml. The patient’s vital sign and blood profiles were within normal limits. Therefore, conservative treatment with close monitoring was maintained.

Postoperative Course. The patient’s pain was relieved as time passed and the follow-up abdominal CT scan revealed a slight decrease in the hematoma size. He was discharged on the 6th postoperative day without significant sequelae.

Case 4

Examination. This 41-year-old woman received a di-
agnosis of herniated lumbar disc at the L3–4 and L4–5 levels (Fig. 4A). She had suffered from right buttock and leg pain refractory to repeated acupuncture therapy and epidural blockade 12 weeks earlier. On physical examination, she showed a 50° right-sided straight leg–raising limitation and Grade 4 muscle power with the big toe in dorsiflexion. The CT scans and MR images revealed subanular disc extrusion at L3–4 and L4–5.

**Operation.** The patient underwent simultaneous transforaminal PELD at L3–4 and L4–5. Similar to the other cases, there was no significant approach-related pain during the transforaminal discectomy. Immediately postoperatively, she felt marked pain relief and returned to the general ward. However, 30 minutes later she began to complain of a sense of dullness and weakness of her right leg combined with mild inguinal pain. Neurological examination revealed a newly developed weakness in hip flexion measured (Grade 3). A MR imaging study was carried out immediately and demonstrated a right-sided 53.3-ml RPH (Fig. 4B). The patient was sent to the ICU, and firm pressure was applied on the operation wound and paraspinal muscle. Four hours after the MR imaging study was performed, a follow-up abdominal CT was performed to examine if the hematoma had progressed. The hematoma was localized around the extraforaminal area at L3–4 and L4–5 levels and had not expanded further. The inguinal pain and muscle weakness began to improve thereafter.

**Postoperative Course.** On the 3rd postoperative day, the patient regained Grade 4 muscle power in hip flexion and was discharged without definite radiculopathy or inguinal pain.

**Discussion**

Hemorrhagic complications of the retroperitoneal space following lumbar disc surgery have been reported as a result of iatrogenic injury of vascular structures anterior to the disc. Most reports were related to open lumbar disc surgery. Although there are reports about...
RPH related to percutaneous procedures such as lumbar plexus block and spinal anesthesia, most hemorrhagic complications related to injection procedures were relatively small in volume and insidious in their clinical courses.

The PELD has been reported as a safe surgery with regard to the major hemorrhagic complications, and only a few reports have mentioned hemorrhagic complications related to PELD. Up to now, there have been no definitive reports regarding symptomatic RPH after PELD. Although there was no obvious technical difficulty and hernia removal was successfully performed, these serious postoperative hematomas were recognized several hours later.

**Mechanism of RPH With Anatomical Consideration**

Regardless of clinical types, there were common features in the postoperative RPH. The common symptom was inguinal pain after a pain-free interval. The patient’s preoperative symptoms improved immediately after the procedure. After a lucid interval, unexpected inguinal pain with or without progressive flank pain and swelling suddenly developed. We postulate that the mechanisms of RPH were closely related to the transforaminal approach itself. First, the initial approach is a fluoroscopically guided blind procedure through the foraminal window before insertion of endoscope. Second, there may be abundant vascular distributions around the extraforaminal portion of the herniated and inflamed disc. Finally, it is difficult to detect extraforaminal bleeding early because significant bleeding may occur outside the working cannula while the endoscopic overview is limited within the cannula. Considering the vascular supply to the foraminal and extraforaminal areas, the terminal branches of the segmental lumbar artery could have been the bleeding foci (Fig. 5). In the initial transforaminal approach, the tip of the needle or other instruments should be kept posterior to the posterior vertebral line before entering into the disc. The region anterior to the posterior vertebral line could contain arterial branches of the segmental lumbar artery. If the insertion angle is too steep and the tip is placed anteriorly before touching the disc, there is a substantial risk of vascular injury. Moreover, an extensive exploration of the extraforaminal space might damage the arterial branches. During the exploration, the working cannula could be frequently placed outside the disc and injure the arteries around the extraforaminal region.

**Types of RPH (Diffuse vs Localized)**

Although the causative mechanism of postoperative RPH was similar, there were 2 discrete clinical types according to the volume and distribution of hematoma. The clinical course and management options were also different between the types.

Cases 1 and 2 were classified as diffuse type RPH. The volume of hematoma was relatively large (> 500 ml) and widely distributed, compressing the intraperitoneal structures to the opposite side. Both patients had peculiar predisposing factors. The patient in Case 1 had coagulopathy with underlying chronic liver cirrhosis. Abnormal vascular configuration around the foraminal area and the patient’s coagulopathy might have caused exceptional bleeding. In the patient in Case 2, the endoscopic discectomy was a second surgical intervention via the same approach route. Fibrotic adhesion and redundant new vessel formation due to previous surgical scarring could be related to the abnormal bleeding. After detecting the hematoma, patients with diffuse-type RPH typically complained of progressive lateral flank pain and swelling in addition to the inguinal pain. Withdrawal bleeding was another common feature of this type. There were no technical difficulties during the procedure. After withdrawal of the instrument, there was some bleeding through the approach wound site. A 1-point skin suture could control the external bleeding. However, we thought this phenomenon might be a warning sign of massive internal bleeding. Consequently, both patients underwent open hematoma evacuation because of increasing pain and residual massive hematoma.

Contrary to the first 2 cases, Cases 3 and 4 were classified as localized-type RPH. The hematoma was relatively small (< 100 ml) and did not shift intraabdominal structures. Therefore, there was no progressive flank pain and swelling. The patients had no associated medical problems or history of previous spinal surgery. The clinical course of the localized type was milder than the diffuse type. In the patient in Case 4, who underwent a 2-level PELD at the L3–4 and L4–5 levels, transient hip flexion weakness was diagnosed instead of severe pain. We postulated that the hip weakness was caused by both the psoas muscle irritation and the extraforaminal nerve root irritation from the hematoma. The detection was ear-
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lier than in the other cases and aggressive wound compression was performed to prevent bleeding propagation. The follow-up CT scan obtained 3 hours later showed no further progression of the hematoma. The localized-type RPH was controlled with conservative management.

Actually, there is no absolute numerical value in hematoma volume to classify the RPH. Rather, the relative volume, which provides a pressure effect to the intraabdominal structures and progressive change in clinical manifestations, can be more important parameters to evaluate the severity of RPH.

Preventive Strategies and Management

To prevent this complication, adequate technical consideration is of the utmost importance. First, the preoperative planning of transforaminal approach on CT and MR imaging is essential. From the axial images at the level of disc space, proper trajectory of the working cannula should be carefully determined to make sure the retroperitoneal structures including vessels do not cross the trajectory. Second, during initial needle placement, it is safer to use a lateral projection than an anteroposterior projection for fluoroscopy. The needle tip should be kept posterior to the posterior vertebral line during needle insertion. An approach along the surface of the superior facet is safe.1-3 If the needle tip passes over the line before landing the disc, there is a risk of retroperitoneal vessel damage. Finally, great care is required during the extraforaminal exploration. Unlike the intradiscal or intracanalicular space, the extraforaminal space is itself loose space and contains many arterial terminal branches. Therefore, unnecessary extensive extraforaminal manipulation may be harmful. To diagnose the RPH early, the surgeon has to observe the patient carefully and have a high index of suspicion. The bleeding pattern after withdrawal of instruments may be helpful. In case of suspicion, early radiological confirmation using CT or MR imaging is recommended. The surgeon should carefully examine the hematoma volume, distribution, pressure effect, and possible offending vessels from the imaging studies. Once the RPH is detected, the treatment options depend on the clinical condition of the patient and the hematoma type. For the diffuse-type RPH with progressive symptoms, surgical evacuation should be considered. If the hematoma is detected to be a localized type, extensive conservative care including aggressive wound compression is mandatory to avoid further surgery.

We performed all procedures and have considerable experience with PELD; the procedures were performed without any technical difficulties. These hemorrhagic complications have neither been recognized nor reported before. As mentioned above, the risk of RPH may be high in extraforaminal endoscopic exploration, rather than in the usual intracanalicular or intradiscal exploration. As the surgeon’s skills improve, the surgical field of manipulation can be extended to the extraforaminal area. Therefore, ironically, the risk of hemorrhagic complications may increase as the surgical techniques become more skillful.

Conclusions

Although PELD is a minimally invasive and safe procedure, the possibility of RPH following the procedure should be kept in mind, as occurred in our cases. Great care should be taken to avoid hemorrhagic complications, especially for patients with underlying medical problems or previous operative scars. Early detection can be helpful to avoid the progression of the hematoma, leading to the need for further surgery.

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