Epidural Hematoma after Incidental Removal of an Epidural Catheter in a Patient Receiving Enoxaparin

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INTRODUCTION

Epidural analgesia is widely used effective modality of postoperative pain control in various kind of surgery. Total knee replacement is one of the procedures that cause severe pain in the first few postoperative days. Following total knee arthroplasty (TKA) surgery, continuous epidural analgesia is an effective method to control severe postoperative pain, to perform early mobilization, and to provide less painful postoperative rehabilitation therapy.

TKA is a major orthopedic operation that presents a high risk of postoperative venous thromboembolism (VTE). Thromboembolism prophylaxis is widely recommended for patients undergoing orthopedic surgery. The use of enoxaparin for thromboprophylaxis increases the risk of epidural hematomas related to epidural catheters.

We report the case of a patient who received thromboprophylactic low molecular weight heparin (LMWH) and developed 14 hours delayed epidural hematoma following the incidental removal of an epidural catheter. We suggest the application of an additional preventive method for fixation and the prolonged paying attention for delayed development of epidural hematoma after removal of epidural catheter.

CASE REPORT

An 82-year-old, 154 cm, 60 kg female patient was scheduled to undergo a left TKA. The patient’s medical history revealed a thirty-year history of diabetes mellitus and hypertension, and surgery for reconstruction of the right knee 3 years prior. Moreover, the patient had a hip screw due to a fracture of the right femur neck 2 years prior, and she was only able to ambulate with an indoor walker. The patient was taking hypoglycemic and antihypertensive agents. The use of aspirin was discontinued 7 days before the surgery. The blood pressure was well controlled, but the serum glucose showed a level of 169 mg/dL, with HbA1c 7.3%. The prothrombin time, partial thromboplastin time, and other laboratory results were within normal range.

The patient was treated with a subcutaneous injection of 40 mg of enoxaparin (LMWH) at 8 pm (12 hours before the elective surgery) for prophylaxis against the development of VTE. In the preoperative regional
anesthesia room, ECG electrodes were applied and the oxygen saturation was monitored with a pulse oximeter. The blood pressure was measured non-invasively at 5-minute intervals. A combined spinal-epidural (CSE) anesthesia was performed in the right lateral position using a CSE kit (CSEcure®, SIMS Portex, Hythe, UK) comprising an 18-gauge Tuohy needle and a 27-gauge pencil point spinal needle at the level of the L3-4 interspace under standard aseptic conditions. On the first attempt, a loss of resistance technique was used to find the epidural space, and clear cerebrospinal fluid was obtained after insertion of the spinal needle. There was no paresthesia. Eight milligrams of 0.5% isobaric tetracaine mixed with epinephrine 1:200,000 were slowly injected through the spinal needle. An epidural catheter was then inserted without resistance and was advanced 4.0 cm upward to maintain the anesthesia during the surgery and to control the patient’s analgesia postoperatively. The procedures were atraumatic, with no bloody tap or blood in the catheter. The epidural catheter was fixed by forming a circular loop at the skin exit site and was kept in place with double tape. The patient was then placed in a supine position and a T10 sensory block was performed. An epidural infusion of 0.188% ropivacaine-fentanyl 10 mcg/mL at 2-4 ml/h was initiated at the end of the surgery.

The patient underwent an uneventful left TKA. Enoxaparin treatment was initiated on postoperative day (POD) 1 at 8 pm (40 mg, subcutaneously, 36 hours later). At 11 pm on POD 1 (39 hours after the end of the operation), the epidural catheter was incidentally removed with patient’s position change. The patient did not complain of any motor or sensory change at that time. The patient was able to ambulate, and underwent scheduled exercise programs without any symptoms. At 1 pm on POD 2 (14 hours after the catheter removal), the patient complained of back and buttock pain, with a score of 7 on the visual analogue scale. At 4 pm, sensory loss and motor weakness were observed in both lower extremities. At 7 pm, the weakness had increased, and the physical examination revealed a bilateral decrease in motor grade of the knee and hip down to 2/5. The ankle dorsi and plantar flexion, as well as the movement of the great toe, were graded 0/5. The sensory level was hypoesthetic, and was below the L2 sensory level.

Immediately, neurology consultation was taken. The neurologist’s first opinion was myelitis. However, when the self-voiding disappeared, an epidural hematoma was suspected, and emergent magnetic resonance imaging (MRI) of the spine was obtained (28 hours after appearance of the first symptoms). The MRI revealed severe spinal canal stenosis with an epidural hematoma extending from L2 to L5 (Fig 1). Urgent decompressive laminectomy L2-5, facetectomy L2-4, and evacuation of the epidural hematoma were performed 30 hours after the appearance of the initial symptoms. The enoxaparin and other anticoagulation treatments were put on hold.

The next day, the S1 dermatome sensory function had been recovered, and the weakness and sensory disturbances were progressively improving. On POD 18 after removal of the hematoma, the patient’s motor grade returned to 3/5 for both extremities. The patient was transferred to the rehabilitation department for further treatment. Three months after removal of the hematoma, the patient’s motor grade returned to 4/5 for both extremities. Eventually, the patient was able to ambulate with a walker again.

**DISCUSSION**

LMWH is used to decrease the risk of thrombotic or embolic events in a wide variety of medical conditions. The prevalence of deep vein thrombosis (DVT)
following total hip or knee replacement without prophylaxis has been reported at 3 to 4%.(1) TKA is a major orthopedic operation which presents a high risk of postoperative VTE.(2) For total hip arthroplasty (THA) or TKA, LMWH consistently reduces asymptomatic DVT by 50%. (1)

It has been suggested that LMWH should be used for prophylaxis against thromboembolism without increasing the risk of bleeding diathesis, as a spontaneous or increased risk of hemorrhagic episodes has been associated with LMWH use. Cardiologists and internists argue that higher doses of anticoagulants lower the risk of thromboembolic (TE) complications, while orthopedic surgeons emphasize the fact that these agents increase the risk of complications such as drainage, bleeding, or deep infection.(1,3,4)

Nevertheless, it is recommended that patients undergoing hip or knee arthroplasty receive LMWH for postoperative VTE prophylaxis.(1) Most institutions have thromboprophylaxis guidelines for patients undergoing major orthopedic surgery.

Enoxaparin has become the LMWH of choice for reducing the risk of VTE, owing to its once-daily administration and equivalent efficacy to unfractionated heparin.(2) Enoxaparin prevents the formation of blood clots by binding with antithrombin and inhibiting the coagulation factors XIa, IXa, Xa and IIa, but the inhibition of the factors Xa is central to its action. Peak anti-Xa activity occurs 3 to 4 hours after subcutaneous enoxaparin injection.(5) Due to the predictability of its effect, enoxaparin does not require laboratory monitoring or dosage adjustments, and there is little intra or inter-individual variability in its effectiveness. Due to reduced protamine binding with LMWH fractions, only the anti-IIa activity of LMWH is completely reversed, whereas the anti-Xa activity is not fully neutralized. Nevertheless, despite its limited ability to reverse anti-Xa activity, protamine can improve hemostasis.(6)

For patients undergoing major orthopedic surgery (e.g., THA, TKA, or surgery for fracture of the femur) and receiving LMWH for thromboprophylaxis, a once-daily enoxaparin dosage regimen of 40 mg is recommended. Twice-daily dosing is advised against, as it is associated with an increased risk of spinal hematoma.(2) In patients receiving preoperative LMWH thromboprophylaxis, the neuraxial anesthesia needle placement should be performed at least 10 to 12 hours after administration of the LMWH dose. Guidelines for postoperative thromboprophylaxis recommend that the

Fig. 1. Magnetic Resonance Imaging. Arrow: epidural hematoma
first LMWH should be administered 6 to 8 hours after the end of the surgery. The second dose should be administered no sooner than 24 hours after the first dose. Indwelling neuraxial catheters may be safely maintained. However, the catheter should be removed a minimum of 10 to 12 hours after administration of the last dose of LMWH, and any subsequent LMWH dosing should be administered a minimum of 2 hours after removal of the catheter removal.(2) At our institution, high-risk surgical and medical patients scheduled to undergo TKA receive enoxaparin 40 mg one day before the surgery, and at 8pm on POD 1 to POD 5. Following our institutional guidelines, the regional anesthesia was performed 10-12 hours after the last injection of enoxaparin, and the epidural catheter was removed at 11 am on POD 3, in accordance with the safety guidelines. In the present case, the epidural catheter was unintentionally extracted due to a movement of the patient 3 hours after subcutaneous injection of the enoxaparin, at peak effect time after injection. Therefore, even though no hematoma was present before removal of the epidural catheter, a small vessel or tissue may have been injured while the catheter was dislodged and may have caused blood accumulation inside the epidural space. The spine MRI revealed that the patient presented severe spinal canal stenosis, which had probably caused the symptoms to develop, even though the spine surgeon who had performed the operation reported that there had only been a small amount of hematoma exiting from the epidural space. Epidural or spinal hematomas rarely resolve spontaneously without surgical intervention,(7) and many cause neurologic injuries, including long-term or permanent paralysis, or even death. Therefore, spinal epidural hematomas require immediate surgical decompression. The outcome depends on the severity of the neurological deficits and on the interval between the onset and the therapeutic intervention.(8) The outcome is generally good if the hematoma is removed within 24 hours of the onset of the symptoms, and is best in patients with incomplete transverse syndrome and in cases of removal of the hematoma within 12 hours of the onset.(9) The presentation of the symptoms is varied. Some patients complain of pain immediately after removal of the catheter, while others show a delayed onset of symptoms.(10,11) Fortunately, this patient suffered no residual neurological deficit despite the delayed diagnosis and treatment (28 hours and 30 hours, respectively). However, anesthesiologists and other related physicians (e.g., orthopedic surgeons or neurologists) should understand the risks of complications related to epidural catheter removal with enoxaparin thromboprophylaxis. Particularly, as previously mentioned, if the onset of the symptoms is delayed after removal of the catheter, the identification of the cause of the neurologic symptoms may be delayed, which may eat up precious time for surgical correction. The epidural analgesia is essential for acute postoperative pain control and rehabilitation and DVT prophylaxis is also recommended because it is proved to reduce morbidity and mortality due to PTE.(1) Therefore, for quality improvement and patient safety, frequent neurologic monitoring, post-anesthesia visits, and the continuous education of orthopedic surgeons and other co-working physicians are essential for the management of patients with an indwelling epidural catheter in the perioperative period. Additionally, a preventive method against the dislodgement of epidural catheters, such as tunneling or suture of the catheter, may be employed for patients receiving thromboprophylaxis.(12,13) Epidural catheter dislocation or dislodgement is a common phenomenon: it has been documented that up to 30-50% of the epidural catheters applied with standard methods of
fixation (tape) dislocate from their original position, and the incidence of epidural catheter dislodgement has been reported at around 21%.(12,14,15) The dislocation of epidural catheters may cause early termination of the postoperative regional analgesia. Moreover, as evidenced by this case, accidental removal shortly after anticoagulant administration may increase the risk of epidural hematoma and neurologic complications. Although we fixed the epidural catheter with a circular loop at the skin exit site through the adhesive foam and covered the catheter with a double-tape method, it was dislodged nonetheless. Regarding the risk of a hematoma after removal of the epidural catheter, we suggest that additional methods should be considered to prevent the movement of epidural catheters.

The protamine reversal could be considered when the epidural catheter dislodged incidentally. As previously described, currently, there is no reversal agent specific to LMWH and protamine has limited ability of reversal the effect of enoxaparin. One case series showed that protamine can decrease hemorrhage expansion and stop active bleeding due to therapeutic dose of enoxaparin.(16) The typical dose of protamine is 1mg per 1mg of enoxaparin administered within the previous 8 hour, with a maximum dose of 50 mg.(17) If greater than 8 hour have elapsed since enoxaparin administration, half dose of protamine is suggested. In this patient, the symptom was occurred lately and emergency operation for hematoma removal revealed small amount of hematoma. It suggested that the bleeding after epidural catheter removal was not acute, active arterial bleeding or large vessel injury. Therefore, half or lesser dose of protamine might be considered in this patient at the time of epidural catheter pulled out accidentally. However, there are controversies about the effectiveness of the protamine reversal(18) and recently published guideline for reversal of antithrombotics in intracranial hemorrhage (ICH) recommend against the reversal of LMWH in patients with ICH receiving prophylactic dosing of LMWH.(6) Further investigation and evidence for protamine reversal in patients with neuraxial anesthesia and analgesia who receives prophylactic LMWH is needed.

Therefore, for patients receiving LMWH, it is critical to follow the guidelines for regional anesthesia and to make efforts to prevent adverse events such as certain fixation. Additionally, prolonged meticulous neurologic monitoring is needed when a catheter is removed accidentally. The preventive protamine reversal can be considered. However, more researches are necessary about the effectiveness, indication and dose.

We report a case of an epidural hematoma following a combined spinal-epidural anesthesia and analgesia. A patient undergoing total knee arthroplasty was postoperatively treated with enoxaparin for thromboprophylaxis. The patient developed the neurologic symptoms after 14 hours from the unintentional removal of an epidural catheter. And the diagnosis was delayed for 28 hours after the appearance of the first symptoms. The neurological recovery was complete even though the evacuation of the hematoma was only performed 30 hours after the appearance of the initial symptoms.

One must pay attention to the delayed onset of neurologic symptoms when epidural catheters are removed earlier than intended during thromboprophylaxis. Prolonged close neurological observation, an additional fixation method and prophylactic protamine reversal may be considerable to manage the patients who use enoxaparin.

**Key words:** Thromboprophylaxis, LMWH, Epidural Analgesia, Enoxaparin
REFERENCES


