Anesthetic management of a spontaneous spinal-epidural hematoma during pregnancy

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ABSTRACT
Spontaneous spinal-epidural hematoma is uncommon and rare during pregnancy. We were presented with a 31-year-old patient who developed back pain with lower extremity paralysis at 36 weeks of gestation. A magnetic resonance imaging scan demonstrated an acute spinal-epidural hematoma and therefore, an emergency cesarean delivery was performed followed by hemilaminectomy with hematoma removal. Anesthesia was initiated with a volatile-based technique which, following delivery of the baby, was changed to target-controlled infusions of propofol and remifentanil. Postoperatively, dopamine was infused to maintain the blood pressure within the high-normal range to optimize spinal cord perfusion. Successful anesthetic and postoperative management is described together with a review of the literature.

Keywords: Spontaneous spinal-epidural hematoma; Pregnancy; Anesthesia

Introduction
Spontaneous spinal-epidural hematoma (SSEH) is an uncommon medical condition and very rare during pregnancy.1–3 Predisposing factors include anticoagulant therapy, arteriovenous malformation, vasculitis and tumors.4 It has also been suggested that increased venous pressure in pregnancy may be a major factor.4 Anesthesia for cesarean delivery in a patient with paralysis has been well documented. However, there are no reports of anesthetic management of a sequential cesarean delivery and spinal surgery because of SSEH during pregnancy. We describe a patient who developed a SSEH at 36 weeks of gestation requiring surgical treatment. The anesthetic management is presented together with a review of the literature.

Case report
A 31-year-old nulliparous woman weighing 65 kg and 160 cm tall (body mass index 25.4 kg/m²) presented to the emergency room at 36 weeks of gestation with a 1-h history of a tingling sensation in her lower extremities. She was very upset. Arterial blood gas analysis showed pH 7.57, PaO₂ 119 mmHg, PaCO₂ 21 mmHg, and SaO₂ 99% in room air. Her past medical history was unremarkable and her pregnancy was otherwise uncomplicated. Routine hematological investigations including coagulation profile were normal and obstetrical ultrasound imaging suggested normal fetal growth. About 5 h after the onset of symptoms, she became calm and described abrupt back pain with lower extremity weakness. Fetal heart rate monitoring was started. Motor examination 6 h after onset of symptoms showed grade 0/5 strength in all muscle groups in the lower extremities; reflexes in the lower extremities were absent. Sensory examination for light touch and pinprick revealed a T4 sensory level. Her rectal tone and perianal sensation were absent. A magnetic resonance imaging (MRI) scan demonstrated a fusiform acute epidural
hematoma from T1 to T5 levels with severe spinal cord compression at the T3 level (Fig. 1). Furthermore, there was an enhancing epidural structure on the left T2 and T3 neural foramen area and T2–3 left epidural space which was suspected to be a vascular lesion.

The obstetrician, anesthesiologist and neurosurgeon urgently reviewed the case. After discussion with the patient, it was decided to perform a cesarean delivery followed immediately by spinal cord decompression in the prone position under general anesthesia. At <15 h from the onset of symptoms, surgery was scheduled. The patient was not premedicated. On arrival in the operating room, standard monitoring was applied. Vital signs were blood pressure 110/70 mmHg, heart rate 80 beats/min and pulse oximetry showed 97% saturation before anesthetic induction. A radial arterial line, right internal jugular central venous catheter and urinary catheter were inserted. The abdomen was prepared and draped for cesarean delivery. After preoxygenation, anesthesia was induced with propofol 100 mg and rocuronium 50 mg. Tracheal intubation was performed using a size 7.0 mm wire-reinforced tracheal tube without difficulty. Blood pressure was 100/55 mmHg and heart rate was 98 beats/min immediate after intubation. Mean blood pressure was maintained between 75-80 mmHg and central venous pressure between 8-10 mmHg by using intravenous boluses of nicardipine 100–200 μg. Anesthesia was maintained with sevoflurane (1–1.5%) in 60% oxygen and air. A cesarean delivery was performed by Pfannenstiel incision and a 2880-g male infant was delivered with Agpar scores of 9 and 10 at 1 and 5 min, respectively. After delivery, sevoflurane was reduced to <1% and fentanyl 100 μg and midazolam 5 mg were given. Intravenous oxytocin 5 IU was administered and a continuous oxytocin infusion was maintained throughout the remainder of surgery. The cesarean delivery was completed uneventfully over 1 h with an estimated blood loss of 500 mL. At the end of the cesarean delivery, the anesthetic technique was changed to propofol and remifentanil using a target-controlled infusion device (Orchestra®, Fresenius Vial, Brezins, France) to facilitate monitoring of somatosensory evoked potentials during spinal surgery. Propofol was adjusted to maintain an effect-site concentration of 2–3.5 μg/mL to obtain bispectral index (BIS) values between 40 and 60, and remifentanil was adjusted to maintain an effect-site concentration of 1–3 ng/mL to maintain hemodynamic stability. The pharmacokinetic sets used for calculation of target effect-site concentrations for propofol and remifentanil were models by Schnider et al. and Minto et al., respectively.

The patient was turned to the prone position on a Wilson frame and after positioning pressure points were checked carefully. Appropriate padding was applied and the tracheal tube position checked by chest auscultation. Her blood pressure was 118/59 mmHg, heart rate 64 beats/min and SaO2 100%. Partial hemilaminectomy from T1 to T4 with epidural hematoma removal was performed uneventfully over 2 h. Operative findings revealed an arteriovenous malformation at the left T2–3 neural foramen and epidural space; the mass was removed. At the end of surgery, all anesthetic agents were discontinued and residual neuromuscular blockade was reversed with pyridostigmine and glycopyrrolate. The

![Fig. 1 Preoperative sagittal T2-weighted image shows a spontaneous epidural hematoma (arrow) located from lower T1 to T5 (A), and axial T1-weighted image shows spinal cord compression and displacement at T3 (arrows) from left anterior and posterior aspect (B, C).](image-url)
tracheal tube was removed when the patient responded to verbal commands and showed sufficient spontaneous respiration and neuromuscular function. There were no signs of uterine atony or postpartum bleeding. Estimated blood loss from the two procedures was 900 mL and the patient received a total of 2300 mL of isotonic crystalloid and 700 mL of colloid together with oxytocin 25 IU. She received patient-controlled intravenous analgesia for 48 h using fentanyl (1000 μg in 100 mL saline). She remained in the post-anesthetic care unit for 1 h event-free and was then transferred to the intensive care unit. Motor examination 1 h postoperatively showed 3/5 strength of the lower extremities. In the intensive care unit, the patient’s mean blood pressure was 65–70 mmHg and heart rate was 54 beats/min. Intravenous dopamine (5–10 μg/kg/min) was given, targeting mean blood pressure 85–90 mmHg for nine days and she was transferred to the general ward on postoperative day 10. An intermittent pneumatic compression device was applied for five days postoperatively and nadroparin (Fraxiparine®, GlaxoSmithKline, Genval, Belgium) was injected subcutaneously for one month as thromboprophylaxis. She had an uneventful recovery with rehabilitation and showed complete recovery of motor function by postoperative day 37.

Discussion

We have described the anesthetic management of a parturient at 36 weeks of gestation who underwent a cesarean delivery followed by spinal cord decompression with laminectomy for SSEH in the prone position under the same general anesthetic. Anesthetic considerations included two urgent procedures, two different positions including the prone position, the physiological changes of pregnancy including the potential for difficult airway management, a premature and viable fetus and the potential for severe intra- and postoperative bleeding.

The etiology of SSEH during pregnancy remains uncertain. It has been suggested that low pressure in the epidural space compared with venous pressure may predispose to a rupture of a pre-existing pathological venous wall. A sudden change in central venous pressure may be transmitted directly from visceral cavities to the epidural veins which have a primitive valveless system. As the uterus enlarges during the third trimester, venous pressure within the epidural venous system increases as does the frequency of SSEH. Although there have been several reports of epidural hematomas localized to the cauda equina with mild neurological deficit which were managed conservatively with good outcome, it is recommended that surgery be performed in patients with acute deterioration in neurologic signs. In the case of SSEH in full-term pregnancy, the fetus should be delivered first by cesarean delivery because venous pressure increases with uterine contractions and the hemodynamic changes of labor may result in further hemorrhage. A shorter interval between the development of symptoms and surgery provides better outcome of motor recovery. When there is complete sensory and motor loss, surgical intervention within 36 h of onset of symptoms correlates with favorable outcome. However, when groups were subdivided, patients treated in <12 h had a greater complete motor recovery rate than patients treated between 12–24 h and 24–36 h (52% vs. 25% vs. 23%, respectively). In our case, we confused neurologic symptoms with labor pain and hyperventilation symptoms, and the diagnosis and surgical procedures were delayed until 15 h after the onset of symptoms. However, our patient fortunately had complete recovery after two months.

In cases such as this, attenuation of the hypertensive response to laryngoscopy and tracheal intubation should be considered. For example, remifentanil, a rapid and short-acting opioid, has been successfully used to attenuate the hemodynamic and catecholamine responses following tracheal intubation in severe pre-eclamptic patients undergoing cesarean delivery. Propofol also attenuates the pressor responses associated with laryngoscopy and has no adverse effects on maternal hemodynamics, umbilical cord blood gases, Apgar scores and neurobehavioral scores. In our case, we used only propofol (1.5 mg/kg) during anesthesia induction. However, in retrospect, the use of a larger dose of propofol and/or addition of a rapid-acting opioid may have been appropriate.

Successful lumbar disc surgery in the lateral position in a pregnant woman has been previously reported. However, the lateral position makes the surgery technically difficult, increases the duration of surgery and the risk of bleeding. In addition, it may be difficult to monitor fetal heart rate and uterine activity in the prone position and more difficult to perform an emergency delivery if needed. In our case, the patient was 36 weeks pregnant and the obstetrician and neonatologist recommended cesarean delivery before spinal surgery. Delivery facilitated the prone position and decreased the risk of epidural bleeding. Also, the fetus was spared exposure to radiation during spinal surgery.

We considered it important to avoid hypotension because a decrease in spinal cord blood flow has been associated with secondary injury after spinal cord injury. Because mean arterial pressure and central venous pressure correlate with spinal cord perfusion pressure, we monitored arterial and central venous pressures invasively before induction of anesthesia and strictly controlled hemodynamics during surgery with small doses of nicardipine.

During spinal surgery, neurological deterioration may result from compression, stretching, vascular insufficiency or direct trauma of the spinal cord. To overcome these limitations, somatosensory evoked potentials have been introduced for neurological investigation and monitoring of the integrity of neural pathways during surgical
procedures. Since volatile anesthetics have a depressant effect on evoked potentials, a recent study has evaluated the performance of total intravenous anesthesia using propofol and opioids. \(^1^6\) By using a standardized anesthetic protocol with computerized target-controlled infusion devices, the impact of anesthesia on preoperative somatosensory evoked potentials could be predicted. \(^1^7\)

Independent use of oxytocin can reduce the risk of postpartum bleeding up to 40\%. \(^1^8\) It is difficult to monitor uterine atony in the prone position and vaginal bleeding can be hidden under surgical drapes. Therefore, we continued the oxytocin infusion prophylactically during the hemilaminectomy and hematoma removal.

In the immediate postoperative period, blood pressure was within low normal limits in the intensive care unit. However, we used dopamine to increase spinal cord perfusion pressure. Perfusion of the spinal cord under normal physiological circumstances is maintained over a wide range of systemic blood pressures by autoregulation. Hindered autoregulation after spinal cord injury exacerbating the local perfusion of the spinal cord can increase vulnerability to systemic hypotension. A previous report suggested that maintaining mean arterial blood pressure >85 mmHg for the first seven days may enhance neurological outcomes following acute spinal cord injury. \(^1^9\)

In conclusion, combined cesarean delivery and partial hemilaminectomy were successfully performed under general anesthesia in a parturient at 36 weeks of gestation. Although SSEH during pregnancy is rare, it can cause paraplegia, quadriplegia, spinal shock and mortality. Prompt diagnosis and surgical intervention involving a multidisciplinary team are necessary for a good clinical outcome.

References
