Obstetric Forum

Anesthesia for Cesarean section in a patient with paraplegia resulting from tumour metastases to spinal cord

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Purpose: Spinal cord injured patients present multiple unique challenges to the anesthesiologist. These include choice of muscle relaxant and management of autonomic hyperreflexia. We report the anesthetic management for Cesarean delivery in a patient who was paraplegic due to spinal canal metastases. Preeclampsia and fever complicated this case.

Clinical features: The patient presented at 29 wk gestation with progressive paraplegia at the T_{10} level due to metastatic osteosarcoma. She had a decompressive laminectomy without improvement in her paralysis. She subsequently developed preeclampsia at 31 wk gestation, and underwent Cesarean delivery for breech presentation under general anesthesia. Anatomical concerns left us unsure of the efficacy or safety of neuraxial anesthesia.

Conclusions: Preeclampsia and autonomic hyperreflexia are generally indications for regional anesthesia for Cesarean section. Tumour in her spinal canal and laboratory abnormalities including thrombocytopenia and a potential urosepsis dissuaded us from this option. Additionally, rapid sequence induction and intubation were not preferred due to paraplegia, leading us to secure the airway fibreoptically.

Objectif : Les lésions de la moelle épinière représentent de nombreux défis anesthésiques particuliers comme le choix du myorelaxant ou le traitement de l'hyperréflexie autonome. Nous décrivons la conduite anesthésique adoptée pendant la césarienne d'une patiente paraplégique, à cause de métastases au canal rachidien, qui présentait aussi une prééclampsie et de la fièvre.

Éléments cliniques : L'examen de la patiente révélait, à 29 sem de grossesse, une paraplégie progressive à T_{10} causée par un ostéosarcome métastatique. Une laminectomie décompressive a été pratiquée sans changer la paralysie. À 31 sem, une prééclampsie s'est développée et, étant donné une présentation par siège, une césarienne sous anesthésie générale a eu lieu. Les problèmes anatomiques nous ont fait douter de l'efficacité ou de la sécurité de l'anesthésie régionale.

Conclusion : La prééclampsie et l'hyperréflexie autonome sont généralement des indications d'anesthésie régionale pour une césarienne. La tumeur du canal rachidien et les anomalies rapportées par le laboratoire, y compris une thrombocytopénie et une uropathie, nous ont dissuadés de l'utiliser. De plus, la paraplégie nous a amenés à privilégier la fibroscopie, plutôt que la séquence rapide pour l'induction et l'intubation, afin de protéger les voies aériennes.

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PATIENTS with spinal cord injuries present multiple unique considerations for anesthesiologists. These include choice of muscle relaxant, potential for autonomic hyperreflexia (AH), and fluid management. With improved medical care of the spinal cord injured patient, pregnancy is seen more commonly in this population. We report the anesthetic management of a parturient, with T_{10} paraplegia due to tumour metastases, who was diagnosed with severe preeclampsia. Obstetric management necessitated Cesarean delivery. We are aware of no prior case reports of anesthesia for Cesarean section (C/S) in a patient with preeclampsia and paraplegia due to tumour.

Case report

The patient was a 19-yr-old woman, G1 P0 at 31 wk gestation. She had a history of osteosarcoma of the left leg. A biopsy of her foot at 22 wk gestation under spinal anesthesia, revealed osteosarcoma, necessitating a below knee amputation. Chest radiographs (posterior-anterior and lateral) revealed no metastases. At 29 wk gestation she presented with lower extremity weakness, proceeding to paraplegia. MRI revealed metastases at the $T_{8\text{-}11}$ and $L_{4\text{-}5}$ vertebral bodies and anterior extradural space at the $T_{9\text{-}10}$ level. The patient underwent an uncomplicated decompressive laminectomy at the T_9 level for severe central canal stenosis and moderate compression of the spinal cord. This was done under general anesthesia in the lateral decubitus position. There were no anesthetic complications. She had a residual incomplete $T_{9\text{-}10}$ paraplegia. Medical management consisted of adriamycin and dexamethasone.

Approximately two weeks postoperatively she developed pyelonephritis, a fever of 39.5 C, with accompanying fetal tachycardia (190 bpm) despite antibiotic therapy. Her urine culture grew E. coli. She also developed hypertension (147/84, 150/90 mmHg), pitting edema and proteinuria (900 mg·24hr^{-1}), prompting the diagnosis of severe preeclampsia. The diagnosis was based on her evolving clinical picture, including the development of thrombocytopenia, rather than strict textbook criteria. Specifically, she did not have headache, epigastric pain, oliguria, or blood pressures greater than 160 mmHg systolic or 110 mmHg diastolic. The obstetrician planned a Cesarean section based on persistent breech presentation, non-reassuring fetal heart tracing, and preeclampsia. Magnesium sulfate prophylaxis was begun.

Physical examination revealed an obese woman (height 165 cm, weight 114.5 kg) with moderate peripheral edema. Her airway was Mallampati class 2 with a 5-cm thyromental distance. She had nearly complete paraplegia at the T_{10} level. Her blood pressure was 120/64 mmHg after treatment with magnesium sulfate, pulse was 100 bpm, and temperature was 39.5C. The remainder of her examination was unremarkable. A computed tomography (CT) scan of the head was obtained on the day of her surgery. The results were normal. Fetal heart rate was 170-190 bpm, with minimal long-term variability. Laboratory results included 24 hr urine containing 900 mg protein and a platelet count of 79,000·μL^{-1}. There was no other evidence of coagulopathy. Liver function tests were normal. Serum magnesium was 1.6 mg·dl^{-1}.

Due to concerns about her spinal anatomy, residual tumour, recent laminectomy, and diminishing platelet count, general anesthesia was planned. The patient received sodium citrate 30 ml *po* and was positioned supine with left uterine displacement. An 18 gauge *iv* was placed, with lactated Ringer's solution. In addition to ECG and pulse oximetry, an arterial line was placed prior to induction. She received 0.2 mg glycopyrrolate *iv* and 1.25 mg increments droperidol *iv* (total 5 mg) prior to topicalization of her airway with aerosolized lidocaine 4%. Once adequate anesthesia of the airway was achieved, an oral 7.0 mm endotracheal tube was guided over a fibreoptic bronchoscope. After confirmation of $P_{ET}CO_2$, anesthesia was induced with 250 mg thiopental *iv* in divided doses. There was no hemodynamic response to induction, and blood pressure stayed within 15% of her starting pressure of 118/55 mmHg throughout the case. She received isoflurane 0.5% and $0_2/N_2O$ 50%/50% for maintenance before delivery. The patient underwent a low transverse Cesarean section via Pfannenstiel skin incision with an estimated blood loss of 750 ml. Fluid replacement totaled 2000 ml of lactated Ringer's solution. Surgical time was 45 min. A male infant weighing 1885 g was delivered. Apgar scores were 2/3/6 at 1/5/10 min with an arterial cord blood gas pH of 7.30. Once the baby was delivered her anesthetic was supplemented with 200 μg fentanyl *iv* and nitrous oxide was increased to 70%. She was hemodynamically stable throughout the case and the trachea was extubated without incident at the end of the procedure. Her postoperative course was uneventful, receiving intravenous magnesium sulfate for 24 hr.

Discussion

It is important to distinguish autonomical hyperreflexia from preeclampsia in this setting. The characteristics of autonomic hyperreflexia are sudden, severe, intermittent increases in blood pressure accompanied by bradycardia, piloerection and sweating below the level of the spinal cord lesion, and vasodilatation and

flushing above the level of the lesion.[1,2] Headache and intracerebral hemorrhage can be seen with either AH or preeclampsia. The hallmarks of preeclampsia are sustained hypertension, proteinuria, and edema, with or without central nervous system symptoms. There was no sign of AH in this patient either preoperatively or intraoperatively. She did meet the criteria for preeclampsia. There is no increase in the incidence of preeclampsia in spinal cord injured parturients than in the normal population.[7,8,9]

The level of the spinal cord injury is the best predictor of developing AH. Lesions higher than T_5 are very prone to develop AH, while in lesions below T_{11} it is uncommon.[2,3] Patient with incomplete spinal cord lesions are less likely to develop AH, as the descending inhibitory tracts have a greater likelihood of being intact. Since this patient had a relatively low and incomplete injury, her likelihood of developing AH was low. However, regional anesthesia would have been preferred as she was at risk.[2] Neuraxial regional anesthesia prevents autonomic hyperreflexia[1,2,4,5] when an appropriate sensory level is achieved. It may be difficult to determine a sensory level from regional analgesia in a labouring, paraplegic patient. Autonomic hyperreflexia in the face of a failed epidural catheter has been seen and treated by replacement with a working catheter.[6]

Breech presentation, preeclampsia, and maternal fever with fetal tachycardia prompted Cesarean delivery. Regional anesthesia would have been preferred to avoid the complications of preeclampsia including potentially difficult airway and excessive hemodynamic response to laryngoscopy. An increase in the inhaled concentration of volatile anesthetics during general anesthesia can lead to neonatal depression, uterine atony and an increase in the blood loss during a Cesarean section.[10] Obviously these are undesirable side effects. Volatile anesthetics can be used during a general anesthetic to treat the hemodynamic sequelae of autonomic hyperreflexia.

Thrombocytopenia was one deterrent to regional anesthesia. The hematologists thought it unlikely that the thrombocytopenia was from chemotherapy rather than from preeclampsia. The patient's fever and possible urosepsis was another deterrent to regional anesthesia. Blood cultures were drawn on the day of surgery. Epidural hematoma and abscess may not be as catastrophic in this patient as in the normal population, but may have increased the chance of further urgent surgery, or decreased this patient's rehabilitation potential. We perceived that the tumour in her spinal canal and the previous back surgery might make epidural catheter placement difficult,[1] and the block ineffective due to restricted local anesthetic spread in the epidural space. Bolus administration of local anesthetic in the epidural space may have caused further compression of the spinal cord. Considering the potential to introduce tumour into the cerebrospinal fluid during a spinal block, we chose to avoid this option. While introduction of tumour into the CSF with a spinal needle may not be a well described occurrence, we did not want to feel responsible if tumour extension into the subarachnoid space occurred. Positioning for neuraxial regional anesthesia in this obese, paraplegic patient also would have been difficult. We did not see an absolute contraindication for neuraxial anesthesia, but in our opinion general anesthesia was preferable.

While her airway appeared sufficient for intubation under direct laryngoscopy, rapid sequence induction of general anesthesia was undesirable due to the choices of muscle relaxants. Succinylcholine is contraindicated in paraplegia. We felt a rapid sequence dose of a nondepolarizing muscle relaxant (specifically rocuronium) would have lasted longer than the surgical time of 45 min, especially with concurrent magnesium therapy, and could have resulted in the need for postoperative ventilation. Rapacuronium was not available at the time of this case. Awake fibreoptic intubation had the advantage of avoiding neuromuscular blockade and the potential hemodynamic consequences of direct laryngoscopy, including acutely elevated blood pressure and intracranial hemorrhage in the preeclamptic patient. In additional, preeclampsia and pregnancy are associated with more difficult intubation even with a normal appearing airway exam. Therefore, we chose awake fibreoptic intubation.

We chose droperidol as the sedative during fibreoptic intubation because of its lack of respiratory depression in both the mother and the infant. Droperidol has been used as an analgesic in labour without any ill effects on the pH, PCO_2, or PO_2 of the neonate.[11] This agent worked quite well in providing sedation for the awake fibreoptic intubation.

Our initial evaluation included a CT scan of her head to evaluate for intracranial metastases or intracranial hypertension that might change our anesthetic/ventilatory management, delay emergence, or cause seizures that would necessitate differentiation from eclampsia or intracranial hemorrhage. The presence of intracranial edema would have changed our fluid management. The scan was normal at the time. Of note, six months after delivery the patient presented with complex partial seizures due to three calvarial metastases.

This patient had multiple co-morbid diseases. Her conditions, including spinal cord injury and preeclampsia, made regional anesthesia desirable,[2] but

the specifics of her diseases, including spinal canal tumour, thrombocytopenia, and fever, made general anesthesia preferable. Awake oral fibreoptic intubation proved an excellent way to manage her airway. This patient displayed no signs of autonomic hyperreflexia and had no anesthetic complications.

Commentary

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Jones *et al.* have presented an interesting case report with 'classical' anesthetic conflicts. Epidural analgesia for the obstetrical patient who presents with preeclampsia or paraplegia with autonomic hyperreflexia may be extremely beneficial and therapeutic.[1] On the other hand, the combination of recent back surgery, thrombocytopenia, a developing and evolving neurological deficit in the face of a febrile parturient with known urosepsis, renders regional analgesia or anesthesia less favourable, if not contraindicated.

As more women with paraplegia are surviving and presenting for surgery and obstetrical care, it is important for anesthesiologists to be aware of the unique considerations in this population including the development of autonomic hyperreflexia.

Immediately after traumatic cord injury, a period known as 'spinal shock' ensues which results from a sudden loss of sympathetic nervous system input. Hypotension, bradycardia, muscle flaccidity and loss of reflexes are hallmarks of this stage.[12] Over the course of the first few days to weeks after injury, sympathetic function gradually returns along with muscle tone and reflexes. Once the initial spinal shock stage is over, the potential for the patient to develop autonomic hyperreflexia exists. Hypertension, piloerection, flushing, sweating and reflex bradycardia are common symptoms occurring with stimulation below the level of the lesion.[1] Bladder distention is a common precipitating factor, but uterine contractions, urinary tract infections and acute abdominal pathology are other causes.[12–14]

The presence or development of autonomic hyperreflexia is related to the level of the spinal cord lesion, with a quoted incidence of 85% if the lesion is higher than T_7.[15] This syndrome is relatively uncommon in lesions below $T_{8\text{-}10}$.[16] The exaggerated sympathetic response relates to the development of presynaptic boutons that develop in a haphazard, chaotic fashion over a period of weeks following injury.[12] Massive vasoconstriction, unresponsive to the usual descending inhibitory influences, accounts for the profound rises in blood pressure.

Institutional experience with spinal cord injured patients during labour and delivery has been summarized by Baker and Westgren.[13,14] In a retrospective chart review of 29 obstetric patients with traumatic spinal cord injury over a period of 11 yr, 12 had lesions above T_5 and 17 below this level.[14] Nine of the 12 higher lesions exhibited evidence of autonomic hyperreflexia during labour and delivery. Using a computer search of a 10-yr obstetric experience at the University of Washington, 11 women with infectious or traumatic spinal cord injury were identified.[13] Two women (lesions above T_6) had episodes of intrapartum autonomic hyperreflexia.

The patient in this case report had metastatic lesions with an incomplete $T_{9\text{-}10}$ residual deficit despite decompressive laminectomy. The deficit appears to have developed over a course of about two weeks prior to her presentation for Cesarean section. Due to the level of the lesion and its recent onset, it would be highly unusual for autonomic hyperreflexia to have been an issue in the care of this patient. The fact that she underwent an uneventful general anesthetic for the decompression laminectomy two weeks previous without any cardiovascular instability (i.e. hypotension, bradycardia), certainly suggests that the nature of the physiological effects of the spinal metastases was likely minimal.

The feasibility of administering regional analgesia or anesthesia in a patient with recent back surgery is not completely straightforward. Neurosurgical opinion from our institution suggests that there is no contraindication to spinal anesthesia two weeks post-laminectomy *per se,* but adds that epidural anesthesia might be technically challenging and possibly inadequate. Many anesthesiologists would be hesitant to proceed with regional anesthesia in the face of an 'unstable' neurological lesion, such as was present in this patient. Should her neurological status deteriorate after regional anesthesia for Cesarean section, it would be difficult, if not impossible, to determine the exact cause without invasive investigation or surgery. The opinion of my surgical orthopedic oncology colleagues was that regional anesthesia should be absolutely avoided in a case such as this. The concern did not centre around 'seeding' of the neuraxis with tumour, but rather the question of how to proceed if her neurological status were to change.

This patient does not meet the ACOG criteria for severe preeclampsia since she was neither hypertensive nor did she have proteinuria > 5 gm·24 hr^{-1}.[1,17] It is the opinion of our experts in the treatment of osteosarcoma that the finding of 'developing thrombocytopenia' may well be explained on the high incidence of bone

marrow suppression with the use of adriamycin which often peaks in the two week period following institution of the drug. This is contrary to the opinion of the oncologists mentioned in the case report who felt it more likely that 'severe preeclampsia' was responsible. The lack of any other supportive evidence of the diagnosis of severe preeclampsia, in my mind, makes the likelihood of adriamycin induced thrombocytopenia more likely.

The authors chose to perform awake fibreoptic intubation (FOI) to avoid muscle relaxants and the potential hemodynamic consequences of direct laryngoscopy, including acutely elevated blood pressure. Studies in patients under general anesthesia have not demonstrated any difference in hemodynamic changes between direct laryngoscopy and FOI.[18–20] Personally, I would have done a rapid sequence induction using 0.6 $mg \cdot kg^{-1}$ rocuronium, recognizing that prolongation of the block can occur. Time to clinical recovery using vecuronium for rapid sequence induction was prolonged by a mean of 18 min with magnesium pretreatment and a similar prolongation (mean of 15 min) was seen with magnesium pretreatment and the use of 0.6 $mg \cdot kg^{-1}$ rocuronium.[21,22] If the patient's neuromuscular block could not be reversed at the end of the surgery, I would have continued ventilation in the operating room until full recovery had taken place.

Commentary

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The authors present the case of a young woman whose pregnancy was complicated by paraplegia, preeclampsia, thrombocytopenia, sepsis and non-reassuring fetal status. After considering the risks and benefits of regional and general anesthesia, general anesthesia was selected for the Cesarean delivery. The authors did not feel that regional anesthesia was absolutely contraindicated, but they preferred general anesthesia. While the possible complications of regional anesthesia were fully discussed, the risks of general anesthesia were not presented.

Hawkins *et al.*[23] reviewed anesthesia-related maternal mortality in the United States from 1979 to 1990. They reported that risk for maternal mortality with general anesthesia after 1985 was 16.7 times that of regional anesthesia. Most of the anesthesia-related deaths occurred during general anesthesia for Cesarean section.

As knowledge of complications from regional and general anesthesia increased, management of regional anesthesia improved to a greater extent than general anesthesia. Comparing the 1985-1990 period with the 1979-1985 periods, general anesthesia was responsible for an increasing proportion of the total deaths.

This patient's medical problems led to a modified general anesthetic technique. The authors were concerned about side effects from muscle relaxants, possible difficult intubation, and hemodynamic responses to a rapid sequence intubation. Droperidol sedation and awake fibreoptic guided intubation were used to secure airway control prior to induction of general anesthesia. The authors utilized droperidol in 1.25 mg increments to a total of 5 mg for sedation during fibreoptic intubation.

Droperidol is not the usual choice of sedative for awake, tracheal intubation. Droperidol has been reported to cause delayed psychological effects. Melnick *et al.*[24] observed 23% of patients given 1.25 mg droperidol developed anxiety or restlessness after minor outpatient surgical procedures. None of the control patients who did not receive droperidol had any of these reactions.

The neonate had Apgar scores of 2/3/6 at 1/5/10 min with an arterial cord blood gas pH of 7.30. While the premature gestation probably was responsible for the low Apgar scores, the effects of medications cannot be excluded.

The authors were unsure about the safety of regional anesthesia because of thrombocytopenia, systemic sepsis and tumour metastases at the $T_{8\text{-}11}$ and $L_{4\text{-}5}$ vertebral bodies and anterior extradural space at the $T_{9\text{-}10}$ level. The patient had residual incomplete paraplegia after a decompressive laminectomy. As the authors pointed out, epidural hematoma and abscess may not be as catastrophic in this patient as in the normal population.

While coagulation abnormalities are contraindications to regional anesthesia, there is some controversy about the platelet level that constitutes abnormal coagulation. Beilin *et al.*[25] reviewed the records of 80 pregnant women with platelet counts between 69,000 and 98,000 $\cdot \mu L^{-1}$. Thirty of these women had an epidural anesthetic placed when the platelet count was 69,000-98,000 $\cdot \mu L^{-1}$. Twenty-two women had an epidural anesthetic placed with a platelet count greater than 100,000 $\cdot \mu L^{-1}$ that subsequently decreased below 100,000 $\cdot \mu L^{-1}$: none of the patients developed neurologic symptoms. In another study,[26] 14 of 24 thrombocytopenic patients (platelet counts 15,000-99,000 $\cdot \mu L^{-1}$) received regional anesthesia, and none had permanent sequelae. The patient in the current report had a platelet count of 79,000 $\cdot \mu L^{-1}$. There was no other evidence of abnormal bleeding. The risk

of a major neurological complication is probably relatively small.

The authors were influenced by the patient's pyelonephritis, a fever of 39.5C and growth of E. coli in the patient's urine. Antibiotics had been started. Two retrospective reviews[27,28] assessed the risk of complications after regional anesthesia in 850 patients who had chorioamnionitis. Twenty-one patients had documented bacteremia and 16 of them received epidural or spinal anesthesia. None of the women developed epidural or spinal abscess or meningitis. The leukocyte counts and temperature elevations were not predictive of patients with bacteremia. While there are only a few clinical studies, many obstetric anesthesiologist will provide epidural anesthesia to labouring patients with fever after antibiotic therapy has been started.

Due to the rarity of complicated cases such as the one presented, there is little experience to guide us in the management of these patients. We must consider the literature, our own experience and skills, discuss the risks and benefits of the procedures with the patient and our obstetric colleagues in arriving at the anesthetic plan. As the authors pointed out, the patient's associated medical conditions were not absolute contraindications to regional anesthesia. Both regional anesthesia and general anaesthesia might have provided the desired outcomes without serious complications.

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