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Continuous spinal anesthesia and postoperative analgesia for elective cesarean section in a parturient with Eisenmenger's syndrome

Shigeki Sakuraba, Shuya Kiyama, Ryoichi Ochiai, Shinichi Yamamoto, Tatsuya Yamada, Saori Hashiguchi, and Junzo Takeda

Department of Anesthesiology, School of Medicine, Keio University, 35 Shinanomachi, Shinjuku-ku, Tokyo 160-8582, Japan

Abstract We describe the use of continuous spinal anesthesia (CSA) for an elective cesarean section in a 29-year-old parturient with Eisenmenger's syndrome at 30 weeks of gestation. It is essential in patients with Eisenmenger's syndrome to prevent significant increases in right-to-left shunt following the reduction in systemic vascular resistance. In this case, the patient hoped to be awake during the operation because of her fear of death. We therefore applied CSA to this patient because single-shot spinal anesthesia and epidural anesthesia might cause sudden cardiovascular depression. In fact, sudden cardiovascular changes were avoided by the titration of local anesthetics and the operation was uneventful, although prompt treatment of hypotension was essential and adjustment of the anesthetic levels was difficult. Postoperative patient-controlled spinal analgesia provided satisfactory pain relief with hemodynamic stability and no significant side effects. However, thorough experience with the requisite techniques is critical in CSA because of the technical difficulty of the procedure, and anesthesiologists must gain such experience in less-demanding cases before attempting to administer it in patients presenting extreme challenges as described in this case report.

Key words Eisenmenger's syndrome · Continuous spinal anesthesia · Subarachnoid · Cesarean section · Obstetric

Introduction

When managing patients with Eisenmenger's syndrome, it is important to prevent significant increases in right-to-left shunt [1,2]. This is especially true for parturients, who tolerate such increases poorly due to the reduction in systemic vascular resistance (SVR) that occurs during pregnancy [3]. Major regional anesthesia, such as spinal or epidural anesthesia, causes extensive sympathetic blockade and therefore has been considered to be contraindicated for patients with Eisenmenger's syndrome [4]. We describe the use of continuous spinal anesthesia (CSA) for an elective cesarean section in a parturient with Eisenmenger's syndrome.

Address correspondence to: S. Sakuraba
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Case report

A 29-year-old pregnant woman with Eisenmenger's syndrome was admitted to our hospital at 27 weeks of gestation. When she was 8 years old she was diagnosed as having a ventricular septal defect (VSD), but the condition had remained untreated since that time. After becoming pregnant, she had refused a therapeutic abortion at 12 weeks of gestation.

By echocardiography, the patient's pulmonary arterial pressure was estimated to be 100/50 mmHg (systemic arterial pressure, 120/60 mmHg), and Qp/Qs was estimated at 1.9. A membranous VSD (2.3 cm) with bidirectional shunt was confirmed. On breathing room air, the arterial blood gases were Pa_{O_2} 58.3 mmHg, Pa_{CO_2} 29.3 mmHg, and pH 7.46. Arterial oxygen saturation was 90%. Hemoglobin was $15.0\,g \cdot dl^{-1}$, hematocrit was 43.7%, and platelet count was $217 \times 10^9 \cdot l^{-1}$. Electrolytes and prothrombin time were within normal ranges. Transvaginal ultrasonography showed normal fetal growth.

An elective cesarean section was scheduled at 30 weeks of gestation. The patient's exercise tolerance was severely limited. To prevent pulmonary embolism, subcutaneous heparin at 10 000 U per day was started 6 days before cesarean section and was continued until the day before the operation. On the operative day, the activated clotting time (ACT) was 108 s.

The patient was premedicated with ranitidine 150 mg 2 h prior to the operation. In the operating room, the oxygen saturation was 89% while the patient was breathing room air. A radial arterial and a central venous catheter were placed under local anesthesia. The central venous pressure was 10 mmHg.

A 22-gauge over-the-needle spinal catheter (Spinocath, B. Braun, Sheffield, UK) was placed between the 3rd and 4th lumbar intervertebral space in the left lateral position on the second attempt. The catheter was inserted to a depth of 2 cm into the subarachnoid space. However, cerebrospinal fluid (CSF) could not be aspirated through the catheter. After the patient was placed in the supine position with left uterine displacement, 15 μg of fentanyl was injected via the spinal catheter, followed by 2.0 ml of 0.5% isobaric bupivacaine in incremental doses over 8 min. However, sensory blockade reached only to the level of L3. Hyperbaric tetracaine, 11 mg in 10% glucose (2.2 ml), was then given in incremental doses over 10 min, and sensory blockade to T6 was achieved. The systemic arterial pressure decreased from 130 to 110 mmHg. Oxygen saturation ($F_{I_{O_2}}$ 0.4) decreased from 94% to 91%. A bolus of 50 μg of phenylephrine was injected to restore the arterial pressure. During the operation, systemic arterial pressure was maintained by intermittent boluses of phenylephrine and ephedrine (total doses, 1.3 mg and 12 mg, respectively). Fluid balance was maintained with acetate Ringer's solution and hydroxyethyl starch. Oxygen saturation was maintained above 91%.

The 46-min operation was uneventful, and blood loss was minimal. Patient-controlled spinal analgesia [rate, $1\,ml{\cdot}h^{-1}$; bolus, 0.5 ml; lockout time, 10 min; contents fentanyl 300 μg (6 ml), 0.5% isobaric bupivacaine 3 ml, saline 21 ml] and continuous intravenous infusion of phenylephrine ($0.4\,mg{\cdot}h^{-1}$) were started at the end of the operation. The latter was stopped 4 h after its start because the systolic blood pressure was maintained above 130 mmHg.

The patient was transferred to the intensive care unit (ICU). Intravenous heparin at $600\,U{\cdot}h^{-1}$ was commenced 2 h after catheter placement and stopped 4 h before removal of the catheter. Heparin infusion was restarted 2 h after removal of the catheter. The spinal catheter was removed on postoperative day (POD) 1. The ACT was 101 s at removal of the catheter. After removal of the catheter, postoperative pain was controlled by intravenous patient-controlled analgesia [rate, $0.5\,ml{\cdot}h^{-1}$; bolus, 1 ml; lockout time, 10 min; contents morphine 50 mg (5 ml), saline 43 ml, Droperidol 5 mg (2 ml)] from POD 1 to POD 3. The patient remained in the ICU for 2 days. Oxygen saturation was maintained above 86% while the patient was breathing oxygen ($F_{I_{O_2}}$ 0.4). The patient did not complain of any postdural puncture headache (PDPH) and was discharged on POD 12.

Discussion

Childbirth presents significant risks to both mother and child in patients with Eisenmenger's syndrome. Maternal and fetal mortalities are reported as high as 40% and 8%, respectively [5]. Despite being informed of these risks, the patient in this report refused therapeutic abortion. Because the maternal mortality of Eisenmenger's patients in vaginal deliveries (34%) is much lower than that in cesarean sections (75%) [6], we cannot recommend cesarean section as the method of choice for all patients. However, we suggest that it may provide an acceptable method of delivery for patients at notable risk in order to avoid the stress induced by possible prolonged labor for depressed cardiopulmonary function [7]. Furthermore, the use of oxytocin may cause cardiovascular changes [8].

During pregnancy, there typically a 50% increase in intravascular volume and cardiac output, which peaks in the second trimester and remains constant throughout the remainder of the pregnancy [9]. Considering these physiological changes and the fact that the patient's limited exercise tolerance might have increased the risk of maternal mortality and possibly retarded the intrauterine growth of the fetus, we scheduled an elective cesarean section to be performed at the 30th week of gestation.

The goal of anesthetic management of a patient with Eisenmenger's syndrome is the maintenance of SVR to prevent increases in right-to-left shunt [1,10]. Both general and regional anesthetic techniques for parturients with Eisenmenger's syndrome have been reported. In the respiratory management of general anesthesia, intermittent positive pressure ventilation causes decreases in venous return and cardiac output and increases in pulmonary arterial pressure, which together produce an increase in right-to-left shunt [2,10]. Nonetheless, general anesthesia is preferred to regional anesthesia, because the latter may induce excessive sympathetic block and decreased SVR [11]. Regional anesthesia is also associated with the additional risk of subdural hematoma, because heparin is frequently given to parturients with Eisenmenger's syndrome [2]. Despite having been informed of these risks, the patient in this report requested regional anesthesia.

The application of epidural anesthesia has been reported in parturients with Eisenmenger's syndrome undergoing elective cesarean section [7,12,13]. The onset of effect is slower than that of single-shot spinal anesthesia, and cardiovascular changes are relatively gradual. However, the large doses of local anesthetics used can cause myocardial depression and hypotension [10,13], and the risk of bleeding into the epidural space is higher than in spinal anesthesia. Incomplete epidural anesthesia may induce undesirable sympathetic stimulation or the need for intraoperative conversion to general anesthesia [10].

On the other hand, CSA provides a titratable and reliable neuroaxial block using minimal doses of local anesthetics, and has been used successfully in the anesthesia of a parturient with Eisenmenger's syndrome undergoing cesarean section [10]. By giving local anesthetics in small incremental doses, the CSA technique enables the anesthesiologist to reduce the likelihood of sudden cardiovascular changes.

The U.S. Food and Drug Administration (FDA) banned the use of spinal catheters smaller than 24 gauge in 1992 [14] after case reports of cauda equina syndrome induced by CSA with microcatheters [15], and manufacturers abandoned their production [10]. We therefore used the 22-gauge over-the-needle spinal catheter (Spinocath system). The Spinocath system represents a methodological change in the approach to spinal puncture, because the bevel of the introducer needle punctures the dura, while the larger gauge of the catheter exerts a dilatory effect, thereby adapting to the dural perforation and theoretically sealing the dura hole [16]. However, past studies have indicated that the incidence of PDPH with Spinocath is higher than that with the smaller catheter [16,17]. We explained these side effects to the patient and obtained informed consent.

During the procedure, we had to use phenylephrine and ephedrine to treat hypotension and maintain SVR. There were, however, some technical challenges; aspiration of CSF through a fine catheter is sometimes difficult or even impossible, and confirmation of the catheter position can be problematic and the results misleading. It is indicated that maldistribution of local anesthetics results from a caudal orientation of the tip of the catheter and not from the level of the tip or from the baricity of the injected solution [18]. Therefore, the sensory blockade to the expected level achieved even with difficulties made us believe that the catheter position was correct in this patient.

CSA can be used for postoperative analgesia as a natural progression from its intraoperative use [19,20]. Patient-controlled spinal analgesia provides better postoperative analgesia and better hemodynamic stability and has fewer postoperative side effects, such as nausea and vomiting, than single-shot spinal anesthesia followed by morphine patient-controlled intravenous analgesia [19]. Also, intrathecal infusion of small doses of opioids and local anesthetics prevents the high peaks of these drugs in the CSF and can minimize the incidence of undesirable side effects with the larger doses [20]. Therefore, we applied CSA with the same regimen of the solution that was reported in the previous study [20] to postoperative analgesia. The patient obtained satisfactory pain relief without the need for any other analgesics.

In summary, CSA can provide a useful anesthetic approach for parturients with Eisenmenger's syndrome, as sudden cardiovascular changes can be avoided by the titration of local anesthetics, although careful monitoring of vital signs and prompt treatment of hypotension are essential. However, thorough experience with the requisite techniques is critical in CSA because of the technical difficulty of the procedure, and anesthesiologists must gain such experience in less-demanding cases before attempting to administer CSA in patients presenting extreme challenges as described in this case report.

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