Use of remifentanil in general anesthesia for emergency cesarean section in a patient with severe valvular heart disease and pulmonary hypertension

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Citation

Abstract

A 23 year-old, 160 cm, 50 kg, gravida 2, para 1 Pakistani parturient who had severe mitral stenosis (mitral valve area 0.82 cm2, pressure gradient [peak/mean] 40/26 mmHg) and pulmonary hypertension (right ventricular systolic pressure of 87 mm Hg) and moderate aortic stenosis (aortic valve area 1.2 cm2, pressure gradient [peak/mean] 58/30 mmHg) from chronic rheumatic heart disease, had her pregnancy complicated by Rhesus iso-immunization. A transvenous mitral commissurotomy was performed percutaneously under local anesthesia. An emergency cesarean delivery for fetal distress was performed under general anaesthesia with sevoflurane and remifentanil. A live 1.73 kg flaccid male baby was delivered with a heart rate of 60 beats/min and treated with naloxone. The Apgar scores for the baby were 3 and 10 at 1 and 5 minutes respectively. Umbilical cord blood at delivery revealed venous and arterial pH of 7.36 (base excess +1) and 7.31 (base excess -2) respectively. The mother maintained stable haemodynamics and was extubated at the end of surgery. Both mother and baby were discharged from hospital on postoperative day 5. The use of remifentanil in cesarean section in patients with severe valvular heart disease is reviewed and discussed.

INTRODUCTION

Cardiac disease is an important cause of maternal mortality and morbidity in obstetric patients. Rheumatic heart disease resulting in valvular dysfunction is still relatively common in underdeveloped countries. Involvement of multiple valves poses a significant risk to patients requiring cesarean section. Long standing mitral stenosis may lead to pulmonary hypertension, predisposing the patient to the risks of hypoxaemia, respiratory failure and pulmonary oedema, whereas in patients with aortic stenosis the relatively fixed cardiac output and left ventricular hypertrophy makes the heart vulnerable to developing ischaemia. There is no widely agreed consensus on optimal anesthetic management for a specific valve lesion or combined lesions. A number of case reports have suggested the use of remifentanil in the management of high-risk parturients requiring cesarean section under general anesthesia ([1,2,3,4,5,6]). We report a parturient who had severe mitral stenosis and pulmonary hypertension and moderate aortic stenosis from chronic rheumatic heart disease, who had her pregnancy complicated by Rhesus iso-immunization. She was scheduled for emergency cesarean delivery for fetal distress and this was performed under general anesthesia with sevoflurane and remifentanil.

CASE REPORT

A 23 year-old, 160 cm, 50 kg, gravida 2, para 1 Pakistani parturient developed Rhesus isoimmunisation. The fetus was assessed to be anemic with a hyperdynamic circulatory status on ultrasound scan at 29 weeks. In-utero transfusion had been performed at 30 and 32 weeks of gestation. An elective cesarean delivery was planned for the patient at 36 weeks. She had no record of medical disease and had an uneventful vaginal delivery of a full-term baby 2 years previously. The patient claimed good health, but had noticed more breathlessness on exertion in late pregnancy. She was not dyspnoeic at rest and had no pedal edema. On auscultation, a loud mid-diastolic murmur was heard over the apical area. The breath sounds were clear. Hemoglobin, coagulation and serum electrolytes were within normal limits. An echocardiogram revealed severe mitral stenosis (mitral valve area 0.82 cm2, pressure gradient [peak/mean] 40/26 mmHg), moderate tricuspid regurgitation, severe pulmonary hypertension (peak systolic tricuspid valve pressure of 75 mmHg and right ventricular systolic pressure of 87 mm Hg) and moderate aortic stenosis (aortic valve area

1.2 cm2, pressure gradient [peak/mean] 58/30 mmHg). An emergent transvenous mitral commissurotomy was performed percutaneously under local anesthesia and was uneventful. A repeat echocardiogram showed an enlarged mitral valve area of 1.3 cm2, mean mitral valve gradient of around 4 mmHg, mild mitral regurgitation and right ventricular systolic pressure of 50 mmHg.

Soon after the procedure, the cardiotocogram showed persistent decreased variability and an emergency cesarean delivery was scheduled. Due to the deteriorating fetal condition, urgency of the cesarean section and the patient's coexisting aortic stenosis, general anesthesia was planned. Prophylactic ampicillin 2 g was prescribed. The patient received oral ranitidine 150 mg and sodium citrate 0.3M 30 ml was given on arrival in the operating theatre. An intravenous infusion of normal saline (0.9% NaCl) was started and the patient was positioned supine with a left lateral tilt to minimise the effects of aorto-caval compression. She was connected to an ECG, non-invasive blood pressure and pulse oximeter (Datex-Ohmeda S/5, Planar Systems Inc, Oregon, U.S.A.). Having administered 2 mg of midazolam intravenously to relieve anxiety, a 22G right radial intra-arterial catheter and a right internal jugular vein double-lumen 7.5 French gauge central venous line were inserted under local anesthesia. The initial CVP was 18 mmHg and blood pressure 130/80 mmHg. The patient received 100% O_2 at 6 L/min for 3 minutes via a tight fitting mask. During preoxygenation, a urinary catheter was placed. At the end of preoxygenation, an intravenous remifentanil infusion was started at 0.3 μg/kg/min. A rapid sequence induction with cricoid pressure applied was performed with etomidate 16 mg and succinylcholine 100 mg iv. Direct larynogoscopy revealed a grade 1 larynx and a size 7 endotracheal tube was inserted into the trachea. Having confirmed correct tube placement, 25 mg of atracurium was then given. The blood pressure and heart rate after tube placement were 120/80 mmHg and 70 beats/min respectively. Anaesthesia was maintained with O_2 (FiO_2 40-50%), air, sevoflurane (ET 0.6 - 1%) and remifentanil (0.05 - 0.3 μg/kg/min) titrated according to the patient's haemodynamic response. The skin to uterine incision and uterine incision to delivery times were 4 and 5 minutes respectively. Thick meconium-stained liquor was noticed on entering the uterine cavity. A live 1.73 kg flaccid male baby was delivered. He had bradycardia (heart rate of 60 beats/min - average heart rate on the CTG had been 110 beats/min).The baby was treated with endotracheal

suctioning, face mask ventilation and naloxone 0.2 mg intramuscular injection. Four minutes after delivery he was moving all limbs and crying vigorously, and was transferred to the neonatal intensive care unit. The Apgar scores for the baby were 3 and 10 at 1 and 5 minutes respectively. Umbilical cord blood at delivery revealed venous and arterial pH of 7.36 (base excess +1) and 7.31 (base excess -2) respectively.

Surgery finished 36 minutes after delivery. Morphine 6mg and two slow boluses of syntocinon 2.5 units were given. A syntocinon infusion at 10 units/hr was started after delivery. The systolic blood pressure, heart rate and CVP ranged between 110 – 145 mmHg, 50 – 100 beats/min and 18 – 25 mmHg, respectively throughout the procedure. At the end of surgery, atropine 0.6 mg and neostigmine 1.25 mg were given to antagonise the muscle relaxant. The trachea was extubated when the patient was fully awake and able to obey commands. The estimated blood loss was 400 ml and the total intraoperative urine output was 140 ml. The patient had received a total fluid input of 400ml of normal saline by the end of anesthesia. During her stay in the recovery room, another 4 mg of morphine and ondansetron 4 mg were administered. A patient-controlled morphine analgesic pump was used for postoperative pain control. She stayed in the recovery room for 30 minutes with stable hemodynamics (blood pressure 140/80 and pulse rate 70 beats/min) before discharge to the intensive care unit (ICU). The chest X-ray taken in ICU showed cardiomegaly and prominent pulmonary vasculature, but no signs of pulmonary congestion. The patient was discharged from the ICU the next day and had an uneventful recovery with hospital discharge on postoperative day 4.

DISCUSSION

In the U.K. cardiac disease is the second most common indirect cause of maternal death after psychiatric causes and is more common than the most frequent direct cause of maternal death, thromboembolism. It has a maternal mortality rate of 2.2/100,000 [7]. Mitral stenosis is the most common of the lethal cardiac lesions occurring in pregnancy, and is present in 0.3-1.2 per cent of parturients [8,9]. The maternal mortality is 5-17 per cent with severe disease [8,9], and is as high as 30-50 percent when accompanied by pulmonary hypertension [10]. Although carefully titrated lumbar epidural anesthesia is often recommended for patients with uncomplicated mitral stenosis, there is no consensus on the best anesthetic technique for patients with

severe disease [10]. These patients often tolerate the hemodynamic changes of pregnancy poorly as increases in blood volume and cardiac output may cause even mild or moderate mitral stenosis symptoms to become severe as pregnancy progresses. The anesthetic technique in mitral stenosis should prevent rapid ventricular rates, maintain sinus rhythm, avoid large, rapid decreases in systemic vascular resistance, and prevent increases in central blood volume8. Patients with pulmonary hypertension will develop right heart strain and, consequently, become extremely sensitive to reductions in preload and increases in pulmonary vascular resistance.

In this patient with mitral stenosis and pulmonary hypertension, our goal was to provide a stress-free induction of and emergence from anesthesia, avoiding the increases in heart rate, systemic and pulmonary vascular resistance, commonly associated with tracheal intubation and extubation. A carefully titrated epidural anesthetic may have met these goals. However, the deteriorating fetal condition and consequent urgency of the procedure coexisting with aortic stenosis precluded use of this technique. In aortic stenosis, a relatively fixed cardiac output leads to left ventricular hypertrophy with vulnerability to myocardial ischaemia. Regional anesthesia reduces preload and afterload, which may precipitate hypotension and subsequent myocardial and placental ischemia. Similar to mitral stenosis, there is considerable debate on the optimal anesthetic technique for patients with aortic stenosis [11,12]. It is important to maintain adequate intravascular volume in order to ensure filling of the noncompliant hypertrophied left ventricle. Tachycardia should be particularly avoided, since it can lead to myocardial ischemia as a result of reduced coronary blood flow and excessive myocardial oxygen demand.

Opioid-based general anesthesia may have advantages in mitral and aortic stenosis as these drugs have no direct negative inotropic effects and prevent tachycardia. There are a few case reports supporting their use [13,14]. Opioids are, of course, associated with respiratory depression which, although not a concern during maternal controlled ventilation, they will cross the placenta. In the report of Batson and colleague's, a high dose of alfentanil of 125 µg/kg was unsurprisingly associated with profound neonatal respiratory depression requiring tracheal intubation [13]. Remifentanil, the latest synthetic opioid, is metabolised rapidly by non-specific plasma esterases and its principal

metabolite has only about 1/500 of the activity of remifentanil. It has a context-sensitive half life of around 3 minutes irrespective of the infusion duration and it has been used in the management of high-risk parturients requiring cesarean section under general anesthesia [15,16,17,18,19,20]. In our case, we titrated the remifentanil infusion rate according to the patient's hemodynamic response to surgery. At 0.3 µg/kg/min for 3 minutes during induction, there was no rise in blood pressure or heart rate during intubation and no intraoperative tachycardia. Kan and colleagues assessed the pharmacology of remifentanil in neonates [21]. In this study, 19 parturients undergoing cesarean section under epidural anesthesia received an infusion of remifentanil 0.1 µg/kg/min. They demonstrated significant placental transfer with a maternal arterial to umbilical venous remifentanil concentration ratio of 0.88. However, the ratio between umbilical arterial and venous remifentanil concentrations was 0.29, suggesting rapid redistribution and metabolism in the fetus. There was no clinical evidence of respiratory depression in the neonates, since all were "vigorous" with Apgar scores >7 at 5 minutes. In the present case, the fetus was anemic from Rhesus iso-immunization and had intrauterine growth retardation. A more pronounced opioid pharmacodynamic effect might be expected. It is important to notify the pediatrician concerning opioid use so that, as in this case, naloxone can be given immediately after delivery. Although initially apnoeic and bradycardic, the baby responded well to the treatment and was vigorous within 4 minutes. The umbilical cord blood gas analysis suggests that uteroplacental flow was not compromised with this technique. Remifentanil only had a transient respiratory depressant effect on the neonate which was readily reversible with naloxone.

Sevoflurane was chosen to maintain hypnosis. Sevoflurane has a favourable hamodynamic profile and a low blood-gas solubility, allowing swift emergence from anesthesia. In a study comparing sevoflurane with isoflurane in cesarean section, sevoflurane and isoflurane at equianaesthetic concentrations were associated with similar blood pressure and heart rate changes during the operation. Blood loss, uterine tone, and perioperative complications were similar with the two drugs [22]. No vasopressors were required. In order to prevent uterine atony which would be particularly serious in our patient, 2 small boluses of syntocinon were administered after delivery. An alternative would be a quick infusion titrated to maintain stable hemodynamics.

In conclusion, we have demonstrated the successful use of remifentanil and sevoflurane in a woman with mitral stenosis, pulmonary hypertension and aortic stenosis undergoing cesarean section. The technique provided cardiovascular stability with no need for vasoactive medications. Uteroplacental flow was not compromised. Transient severe respiratory depression in the newborn must, however, be anticipated although this can be managed with naloxone.

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