Epidural anaesthesia for labour and Caesarean section in a parturient with a single ventricle and transposition of the great arteries

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We describe a case of a 29-year-old parturient with a single ventricle and transposition of the great arteries who had lumbar epidural analgesia/anaesthesia with a local anaesthetic for labour, emergency Caesarean section and postoperative pain. Her outcome and that of her baby was successful. The anaesthetic techniques used in other parturients with similar congenital cardiac anomalies are reviewed.

On décrit le cas d'une parturiente de 29 ans avec un ventricule unique et une transposition des gros vaisseaux qui a subi une anesthésie-analgésie épidurale lombaire avec un anesthésique local lors du travail, la césarienne d'urgence et l'analgésie postopératoire. L'issue chez la mère et le bébé se déroula sans complication. Les techniques anesthésiques utilisées chez d'autres parturientes avec des anomalies cardiaques congénitales similaires sont revues.

Pregnancy is rare in patients with a single ventricle and transposition of the great arteries (TGA). Single ventricle anomalies occur in only 1.5 per cent of patients with congenital heart disease, and 80 per cent of these patients have TGA with an equal incidence of dextro- and laevo-malpositions.¹ Previously, pregnancy has been

reported in only eight patients with a single ventricle with or without an associated TGA.²⁻⁹ According to Mangano,¹⁰ in parturients with cyanotic congenital heart disease avoidance of regional anaesthetic techniques may be wise because a decreased systemic vascular resistance and/or venous return may worsen the right-to-left-shunt. This case presents the management of a parturient with a single ventricle and laevo-TGA. It is the first report of the use of lumbar epidural analgesia/anaesthesia with a local anaesthetic for labour, emergency Caesarean section, and postoperative pain.

Case report

A 29-yr-old patient was admitted for induction of labour after an amniocentesis indicated fetal maturity. Her complex past medical history included cyanotic congenital heart disease. Five years before this admission, cardiac catheterization revealed a single ventricle, laevo-TGA, ventricular inversion, atrial septal defect, right atrioventricular valve atresia and mild subvalvular and valvular stenosis. Her single ventricle pressure was 120/10 mmHg with a mean pulmonary artery pressure of 15–20 mmHg and a normal pulmonary vascular resistance. Her haemoglobin oxygen saturations (SaO₂) were: inferior vena cava and right atrium 75 per cent, left atrium and ventricle 87 per cent, aorta 88 per cent and pulmonary artery 86 per cent. The ventricular ejection fraction was 28 per cent, and the haematocrit (Hct) was 56 per cent. The patient never had hypercyanotic spells or congestive heart failure.

Her obstetrical history included two spontaneous abortions six years before this admission and an uncomplicated successful pregnancy and vaginal delivery four years prior to admission. Throughout her previous pregnancy, the patient had a Hct of 55–60 per cent and an SaO₂ of approximately 88 per cent. Labour was induced at 35 weeks gestation; the first stage lasted three hours with a fifteen-minute second stage. She delivered vaginally with

Key words

ANAESTHESIA: obstetrical;

ANAESTHETIC TECHNIQUES: epidural;

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TABLE I Haemodynamic data

	Preinduction	Epidural (T_{10})	Epidural (T_5)	Epidural bupivacaine/fentanyl	
				Early postpartum	Late postpartum
Blood pressure (mmHg)	128/82	126/80	122/78	125/82	132/80
Pulse (beats $\cdot$ min $^{-1}$)	72	80	80	78	68
CVP (mmHg)	2	3	4	4	6
SpO $_2$ (%) and (FiO $_2$)	86 (0.21)	89 (0.21)	81 (1.0)	86 (0.21)	87 (0.21)
ABG (FiO $_2$)	7.44/27/46/19/84.6% (0.21)		7.50/20/48/17/88.4% (1.0)		
Respiratory rate (breaths $\cdot$ min $^{-1}$)	16	16	18	16	16

Abbreviations: haemoglobin oxygen saturation by pulse oximetry (SpO $_2$), Arterial blood gas (ABG) listed as pH/PCO $_2$ /PO $_2$ /HCO $_3^-$ /% sat, fraction of inspired oxygen (FiO $_2$).

the aid of a pudendal nerve block and local anaesthetic infiltration into the median episiotomy site. A 1740 g baby girl was delivered with Apgar scores of six and nine at one and five minutes, respectively. The neonate developed respiratory distress syndrome which resolved in two weeks.

In the seventeenth week of this current pregnancy, the patient had a retinal artery thromboembolism despite a stable Hct of 55–60 per cent. Therefore, she was anticoagulated with subcutaneous heparin, and no other thromboembolic events occurred. An echocardiogram done at this time concurred with the previous cardiac catheterization.

On admission for elective induction of labour at 36 weeks gestation, the patient was 162 cm, 67 kg and had a New York Heart Association classification of IIa. Her physical examination was remarkable for central cyanosis, marked digital clubbing, a grade IV/VI systolic ejection murmur heard maximally at the upper left sternal border radiating over the entire precordium into her neck, a grade II/IV diastolic murmur and a gravid uterus. On room air, arterial blood gas analysis revealed a PaO $_2$ 46 mmHg. Oxygen saturation by pulse oximetry (SpO $_2$) was 86 per cent, and the Hct was 55 per cent (Table I). Heparin was discontinued the evening before induction. One hour before induction, the partial thromboplastin time was slightly elevated at 40.1 sec (normal 23–38 sec). All other coagulation studies were within normal limits. The electrocardiogram showed normal sinus rhythm, right ventricular hypertrophy, left axis deviation and intraventricular conduction delay. The chest x-ray was remarkable for a mildly convex upper left heart border, a near normal heart size and mildly increased pulmonary vascular markings.

The patient received gentamycin and vancomycin for prophylaxis against endocarditis because of her penicillin allergy. Monitoring was with a pulse oximeter, electrocardiogram, external tocodynamometer and fetal heart rate Doppler. In addition, a peripheral intravenous catheter,

radial arterial catheter and right cephalic vein central venous pressure (CVP) catheter were placed. Chest x-ray confirmed that the tip of the central venous catheter was positioned in the right atrium. The initial CVP was 2 mmHg. During the placement of these catheters, the patient began to have spontaneous uterine contractions.

After hydration with 450 ml Ringer's lactate, leading to a CVP of 4 mmHg, a lumbar epidural catheter was inserted, using preservative-free saline to test for the loss of resistance.¹¹ The patient was placed in the supine position with left lateral tilt. Her CVP was maintained between 2–6 mmHg with intravenous Ringer's lactate. Bupivacaine 0.25 per cent was then injected through the epidural catheter in 2–3 ml aliquots over 15 min to a total dose of 20 mg (8 ml). A tenth thoracic (T $_{10}$) dermatome level of sensory blockade to pinprick and cold was achieved. After establishing adequate epidural analgesia, oxytocin was begun and infused at 1–3 milliunits $\cdot$ hr $^{-1}$. Two and a half hours after the initial dose, the patient required reinforcement of her epidural analgesia. She received a 6 ml bolus of 0.25 per cent bupivacaine, and a continuous infusion of 0.125 per cent bupivacaine at 8 ml $\cdot$ hr $^{-1}$ was begun which resulted in a sustained T $_{10}$ dermatome level of sensory blockade to pinprick and cold, adequate analgesia and continued intact motor function.

After amniotomy was performed and clear fluid noted, an internal pressure transducer and fetal scalp electrode were placed. There were early fetal heart rate decelerations and mild variable decelerations over the next 30 minutes which culminated in a prolonged, seven-minute, fetal bradycardia. The fetal heart rate decreased from 130 to 70 beats $\cdot$ min $^{-1}$. This bradycardia persisted despite discontinuing the oxytocin, stable maternal haemodynamic variables and multiple maternal position changes. Therefore, an emergency Caesarean section was planned for fetal distress. While moving from the labour room to the operating room with continuous ECG, CVP, and mean arterial pressure monitoring, the patient received 15

TABLE II Literature review

Author (year)	Anomaly	Maternal age	Mode of delivery	Anaesthesia	Pulmonary hypertension	Maternal outcome	Fetal outcome (weight)
Mandel and Hirsh (1963) ²	Single ventricle	?	Vaginal	None	Yes	Died 1 day postpartum	Died 5 months gestation (190 g)
Yuzpe <i>et al.</i> (1976) ³	Single ventricle, I-TGA, PDA, PS, hypoplastic aortic arch	17	Caesarean	General	No	Good	Good 40-week gestation (2150 g)
Seeds and Cefalo (1977) ⁴	Single ventricle, single atrium, PS, One AV valve, Potts shunt	25	?	General	No	Good; hemoptysis	?
Ahmed <i>et al.</i> (1981) ⁵	Single ventricle, PA band, Glenn procedure	19	Vaginal	Intrathecal morphine and pudental block	No	Good	Good; 36-week gestation (1700 g)
Leibbrandt <i>et al.</i> (1982) ⁶	Single ventricle, I-TGA, PDA, mild AR	24	Elective Caesarean	Epidural	Yes	Good	Good; 40-week gestation (1500 g)
		29	Elective Caesarean	Epidural	Yes	Good	Good; 37-week gestation (1520 g)
Stiller <i>et al.</i> (1984) ⁷	Single ventricle, I-TGA, subvalvular PS	23	Elective Caesarean	General	No	Good	Good; 36-week gestation (2353 g)
Copel <i>et al.</i> (1986) ⁸	Single ventricle, I-TGA, subvalvular PS	25	Vaginal	Intrathecal morphine and pudental block	No	Good	Good; 36-week gestation (2880 g)
Baumann <i>et al.</i> (1987) ⁹	Single ventricle, TGA	?	Caesarean	Epidural	No	Good	Good; 38-week gestation (2240 g)
Present case	Single ventricle, I-TGA, ASD, one AV valve, PS, subvalvular PS	24	Vaginal	Pudental block and infiltration	No	Good	Good; 35-week gestation (1740 g)
		29	Emergency Caesarean	Epidural for labour, Caesarean section & postop. pain	No	Good	Good; 36-week gestation (1845 g)

Abbreviations: aortic regurgitation (AR), atrial septal defect (ASD), atrioventricular (AV), patent ductus arteriosus (PDA), pulmonary valve stenosis (PS), levo-transposition of the great arteries (I-TGA)

ml 3 per cent 2-chloroprocaine with 1 mEq NaHCO₃ per 10 ml 2-chloroprocaine; 300 ml Ringer's lactate was given intravenously. A fifth thoracic (T₅) dermatome level of sensory blockade was achieved with no change in maternal haemodynamic status. The patient was given 100 per cent oxygen via a face mask with no change in her pulse oximetric saturation. The Caesarean section was begun, and a tight nuchal cord was noted at delivery. A 1845 g male was delivered with Apgar scores of seven and eight at one and five minutes, respectively.

Postpartum, during skin closure, the patient received 100 µg fentanyl in 6 ml normal saline through her epidural catheter for postoperative analgesia. When the effects of the 2-chloroprocaine dissipated 15 min after the end of the Caesarean section, the patient complained of abdominal pain. Therefore, she was given an overnight continuous epidural infusion of 0.125 per cent bupivacaine with 6.25 µg · ml⁻¹ fentanyl at 8 ml · hr⁻¹ which resulted in excellent analgesia and motor function. The next morning the CVP, arterial and epidural catheters were removed without complications. Subcutaneous morphine and heparin were commenced for pain relief and prophylaxis against thromboembolism, respectively. She was discharged from the hospital seven days later with her baby after an uncomplicated postoperative recovery.

Discussion

Single ventricle anomalies with TGA are rarely seen in

parturients.²⁻⁹ The management of intrapartum anaesthesia in patients with right-to-left shunts should be aimed at providing adequate analgesia while maintaining a favourable balance between systemic and pulmonary vascular resistances and, therefore, blood flow. By minimizing the release of endogenous catecholamines produced by pain and anxiety, adequate analgesia helps to prevent increases in pulmonary vascular resistance. A decreased systemic vascular resistance (SVR) and/or venous return should be avoided because the right-to-left shunt may be increased. Regardless of the anaesthetic technique employed, it is important to maintain adequate venous return in these patients by using intravenous fluids appropriately and avoiding aortocaval compression.

When determining the maternal risk associated with cyanotic heart disease, the presence of pulmonary hypertension is an important factor. Indeed, some investigators have attributed the difference in maternal mortality among Eisenmenger's syndrome (27 per cent), primary pulmonary hypertension (50 per cent) and tetralogy of Fallot (four per cent) to the degree of pulmonary hypertension.¹²⁻¹⁴ In reviewing the cases to date of parturients with single ventricles (Table II), it can be seen that those parturients without pulmonary hypertension have a favourable maternal outcome regardless of the mode of delivery, vaginal versus Caesarean section, or type of anaesthesia, regional versus general.

Unlike previous case reports of parturients with single

ventricle and TGA, this case report describes the use of lumbar epidural analgesia/anaesthesia with local anaesthetics for labour, emergency Caesarean section and postoperative pain. In preparing the patient for emergency Caesarean section, we were aware that the rapid extension of the epidural anaesthetic to a T₅ dermatome level could have led to decreased venous filling and SVR due to increased sympathetic nerve blockade. This could have been detrimental to the balance between pulmonary and systemic blood flow. However, no problem occurred, perhaps because the patient already had a well-compensated partial sympathetic nerve blockade due to epidural analgesia for labour. If a decrease in blood pressure had occurred with a worsening of her right-to-left shunt, we would have treated her with intravenous fluids and neosynephrine, which has been shown to be safe in pregnant patients.¹⁵ Overall, the success of our patient's pregnancies probably was due to her normal pulmonary vasculature. Her subvalvular and valvular stenosis may have protected against pulmonary hypertension.

Patients with cyanotic congenital heart disease are at increased risk of developing paradoxical emboli, such as air and thromboemboli. During this pregnancy, our patient developed a retinal artery thromboembolism. Therefore, heparin was commenced and this was discontinued the night before her elective induction. Polycythemia and the hypercoagulable pregnant state may have contributed to the development of a thromboembolus.^{16,17} The use of regional anaesthesia is controversial in patients who have been on anticoagulant therapy and have abnormal coagulation variables.¹⁶ In using epidural anaesthetics in these patients, there is the possibility of an epidural haematoma. Therefore, a high degree of suspicion should be maintained to detect early spinal cord compression.¹¹ In this case, epidural haematoma formation was unlikely because the patient's coagulation profile was only minimally elevated. The benefit of epidural analgesia/anaesthesia may not only have been excellent analgesia but also, perhaps, a decreased likelihood of postoperative deep venous thrombus formation. Epidural analgesia with local anaesthetics has been shown to decrease the incidence of deep venous thrombosis and pulmonary embolus in certain postoperative patient groups.¹⁸

This case reports not only a successful pregnancy but also the use of epidural analgesia/anaesthesia for pain relief during labour, emergency Caesarean section and postoperative recovery in a parturient with single ventricle and TGA. Therefore, based on a limited number of case reports, any anaesthetic technique, regional or general, may be employed safely in these patients if pulmonary hypertension is absent. However, there are risks of pregnancy to both mother and fetus which

include embolic events, endocarditis, congestive heart failure, dysrhythmias, anoxia, intrauterine growth retardation and an increased incidence of fetal wastage.³ Therefore, in managing these patients a team approach is required with cooperation among obstetricians, cardiologists and anaesthetists.

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