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Cesarean Delivery in a Patient with a Transplanted Heart

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Cardiac transplantation is an accepted procedure for treatment of end-stage cardiac failure. A return to near-normal quality of life can be expected in many patients with a nonrejecting cardiac allograft,[1] and many of these patients will return to the operating room for noncardiac surgical procedures.[2] We report herein the anesthetic management of cesarean delivery in a patient who had previously undergone orthotopic heart transplantation.

CASE REPORT

A 29-yr-old gravida 2, para 1, white female presented for elective, repeat cesarean delivery. She was well until 6 yr prior, when in October 1981, she underwent primary cesarean delivery with spinal anesthesia following failure to progress in labor after an uncomplicated pregnancy. The postpartum course was complicated by rapidly progressive dyspnea and cardiac decompensation. A diagnosis of peripartum cardiomyopathy was made, and after maximal medical therapy failed to improve her condition, she underwent orthotopic heart transplantation in April 1982. Her posttransplant course was uneventful; a single rejection episode was managed with intravenous steroid pulse administration with favorable results. She has remained functionally Class I at New York Heart Association (NYHA) in the interim, as well as during the current pregnancy. Annual cardiac catheterization performed 3 months before the current pregnancy began revealed RAP 4 mmHg, PCWP 6 mmHg, CO 5.4 l/m, normal ventricular wall motion, and normal coronary arteries. Noninvasive echocardiographic evaluations at 25, 30, and 36 weeks gestation confirmed excellent ventricular function (ejection fraction 65%). Maintenance medical regimen included prednisone 25 mg daily, azathioprine 75 mg daily, and aspirin 80 mg daily.

The current pregnancy was uncomplicated until 34 weeks gestation when she presented to the emergency department with rigors, chills, and a fever of 40° C. Blood pressure was 110/70 mmHg, pulse 135, respirations 24, fetal heart rate was 180. There was no evidence of acute rejection or reaction to medication. No obvious source of infection could be elucidated by history or physical examination, and broad-spectrum iv antibiotics were begun. On day 3, six out of six blood cultures grew out *Listeria Monocytogenes.* A 2-week course of ampicillin and gentamycin iv resulted in defervescence and rapid resolution of clinical signs of infection.

Amniocentesis performed at 36 weeks gestation confirmed fetal lung maturity (L/S ratio 3.5, SPC 1250) and elective repeat cesarean delivery was scheduled. On the day of delivery, physical examination revealed no evidence of infection. Her vital signs were: Blood pressure—120/80; Pulse—110; Respiration—16; Weight—92 kg; Temperature—97° F. Laboratory data included: White blood count—5.5; Hematocrit—30%; Blood urea nitrogen—10 mg%; Creatinine—0.8 mg%; Glucose—65 mg%; Prothrombin time—12.9 s; Partial thromboplastin time—25.7 s; Platelets—138 thousand; ECG normal sinus rhythm with no ectopy, normal axis, and incomplete right bundle branch block. Preanesthetic medication consisted of sodium citrate, 30 ml by mouth, and hydrocortisone, 100 mg iv. She received 1500 ml warm (37° C) lactated Ringer's solution iv and while being given oxygen 5 l/m by mask, an epidural catheter was inserted at the L2–3 interspace using the loss-of-resistance to air technique. She was positioned supine on the operating table with 15° left uterine displacement. Monitoring included ECG leads II and V5, finger pulse oximeter, and blood pressure cuff. After a test dose of 3 ml of 2% lidocaine with 1/200,000 epinephrine resulted in no signs of intrathecal or iv injection, 3 ml incremental doses of 2% lidocaine with 1/200,000 epinephrine were administered through the epidural catheter over a 5-min period. After a total of 12 ml *via* the epidural catheter, the patient's heart rate immediately increased from 110 to 150 and 3 mm *ST* segment depression was noted on the ECG. The blood pressure was 135/85 and stable during this episode of tachycardia. Esmolol (Brevibloc®), 60 mg was administered iv in 10-mg increments until heart rate returned to 100, and the ST segments became isoelectric. Blood could not be aspirated from the epidural catheter, CNS symptoms of local anesthetic toxicity were lacking, and motor blockade of the lower extremities was noted. An additional 12 ml of 2% lidocaine without epinephrine was administered epidurally, and a T4 level of sensory anesthesia was obtained. She was delivered of a 3100-gm male infant with no gross fetal anomalies and Apgar scores of 10 and 10 at 1 and 5 minutes, respectively. The surgical procedure was uneventful, and tubal ligation was performed at the patients request. At termination of the procedure, 5 mg of preservative-free morphine was injected epidurally and the epidural catheter removed. Estimated blood loss was 1000 ml. Total fluid replacement comprised 3300 ml of lactated Ringer's solution. Urine output during the procedure was 700 ml. Upon arrival in the recovery room, the vital signs were: BP 117/65 mmHg, P 109, R 18, T° 36.1° C. She remained pain free for approximately 18 h. A patient-controlled analgesia (PCA) device was then used. After a loading dose of 8 mg morphine sulfate (MS) iv, the patient could self-administer 3 mg MS at 10-min intervals with a 30-mg 4-h limit. Satisfactory analgesia resulted over an additional 24 h, at which time oral analgesics were administered and the PCA device discontinued. Postoperative ECG was obtained daily for 3 days and showed no change from preoperative ECG. Serial serum CPK-MB analysis for 24 h postoperatively failed to detect myocardial infarction. She was discharged from the hospital with her infant on postoperative day 6. Echocardiographic examination 2 weeks postpartum confirmed the presence of excellent global ventricular function with no evidence for cardiac decompensation or rejection.

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Discussion

To our knowledge, this is the first reported case of successful pregnancy and cesarean delivery after orthotopic heart transplantation for peripartum cardiomyopathy (PPCM). Two previous reports have described vaginal delivery after orthotopic heart transplantation; one involved spontaneous labor at 38 weeks,[3] the other induced labor at 31 weeks gestation after premature rupture of membranes.[4] Anesthetic was not used in either delivery. Both maternal and fetal outcomes were good. Key *et al.*[5] described a cesarean delivery with epidural anesthesia in a patient 5 yr after orthotopic heart transplantation for an inoperable cardiac tumor. Perioperative monitoring included pulmonary artery catheter, although the patient demonstrated no evidence of cardiac failure during the pregnancy. The immediate postpartum course was uneventful, however, and the patient died 5 months after delivery as a result of acute myocardial rejection owing to self-initiated discontinuation of immunosuppressive therapy. The infant has continued to do well.

This case is unique in that the patient's primary cardiac lesion had been peripartum cardiomyopathy (PPCM). Clinical presentation of PPCM includes dyspnea, fatigue, edema, and cardiomegaly occurring in the last month of pregnancy or several months into the peurperium.[6] The etiology of PPCM is unknown, although numerous theories have been proposed. Nutritional deficiencies,[7] hormonal interactions,[8] maternal-fetal antigen responses,[9] small-vessel coronary artery disease,[10] and peripartum blood volume shifts[11] have all been implicated. No convincing data exist, however, to support any of these etiologies. Furthermore, there is a lack of agreement as to whether or not peripartum cardiomyopathy represents a distinct entity.

The risk of recurrent PPCM with subsequent pregnancies is increased and the mortality is high, particularly if the symptoms last more than 6 months.[3] Thus, patients who have manifested PPCM have often been counselled to avoid future pregnancies. It is not clear if recurrent PPCM truly represents a recurrence of the syndrome, or recrudescence of a quiescent, but ongoing subclinical degree of heart failure. In the latter case, clearly the intervention of heart transplantation should be curative and prevent recurrence. The former scenario, however, may indeed place the transplanted heart at risk of recurrent PPCM, particularly if gestational hormones, maternal-fetal antigen responses, or peurperal blood volume shifts are etiologic. Obviously, one case cannot clarify these issues, but as more patients whose PPCM ultimately requires transplantation,[13] perhaps a trend will ensue.

A brief review of anesthetic implications in patients with transplanted hearts is as follows. A nonrejecting donor cardiac allograft usually demonstrates excellent ventricular function but is completely void of autonomic innervation. Thus, any maneuver or pharmacologic agent acting *via* reflex vagal activity will be free of cardiac effects; however, peripheral actions on vascular tone are maintained.[14,15] Only direct-acting vasoactive agents will have any inotropic or chronotropic effect. Baseline tachycardia is common, owing to absence of vagal tone. Furthermore, complete sympathetic denervation implies that high levels (above T_4) of regional anesthesia would not be expected to result in bradycardia. Ventricular performance is critically dependent on the Starling mechanism, as transplanted hearts are unable to rapidly generate a positive chronotropic response to stress. Thus, increasing preload is useful before anesthetic maneuvers such as rapid thiopental induction or high spinal anesthesia. Furthermore, strict attention to aspesis is crucial in these immunosuppressed patients, and "stress" steroid coverage is usually required.

Epidural anesthesia was chosen, for this patient, as the sensory level could be slowly raised, allowing time and volume loading to aid in compensation for regional anesthetic induced sympathetic blockade. Spinal anesthesia would have produced a rapid vasodilation that may not have been well tolerated in this preload-dependent patient. The option of general anesthesia would have required rapid-sequence induction, also not likely to be well tolerated in this setting. Furthermore, the patient requested to be awake during delivery of her infant.

Epidural anesthesia can indeed result in significant vasodilation, and may thus be considered controversial in light of our decision not to invasively monitor preload. We felt that given this patient's excellent exercise tolerance, and echocardiographic confirmation of preserved ventricular function, invasive hemodynamic monitoring was not warranted. Furthermore, a major cause of morbidity in these immunocompromised patients is infection, and we felt that the risk of catheter-induced sepsis outweighed the information that would be obtained from such monitoring. The only untoward event was development of tachycardia after the initial 12-ml injection of lidocaine 2% with 1/200,000 epinephrine. The possibility of intravascular injection was considered but ruled out when signs of local anesthetic toxicity could not be elicited, blood could not be aspirated *via* the catheter, and an appropriate degree of sensory and motor blockade developed. Resolution of the tachycardia was prompt after a β-blocking agent was given, and continuation of the epidural anesthesia with plain 2% lidocaine resulted in satisfactory surgical anesthesia. It is known that denervated, transplanted hearts demonstrate exquisite sensitivity to β-adrenergic agonists, a phenomenon likely the result of "up regulation," or increased density of β-receptors in

the myocardium.[16] Circulatory effects of epidurally administered epinephrine (a mild increase in heart rate) have long been recognized,[17] and it is thus possible that the initial 12 ml of epinephrine-containing local anesthetic resulted in sufficient blood levels of epinephrine to stimulate a profound tachycardia in this unusually sensitive patient. As we could not be certain that absorbed epinephrine was the etiology of tachycardia in this patient, we felt treatment with a short-acting β-blocking agent was indicated, and no untoward effects were seen. A clinical corollary of this case may be that unexplained tachycardia after administration of epinephrine-containing local anesthetics in a patient with a transplanted heart may be due to profound β-receptor sensitivity. Perhaps avoidance of epinephrine-containing local anesthetics should be considered in this patient population, although our single case cannot establish this with certainty.

That this patient was able to tolerate the physiologic stresses of overt sepsis in the third trimester of pregnancy without cardiac decompensation testifies to the adaptive capacity of a transplanted heart. In addition, the pathogen, *L. monocytogenes,* infects patients with known risk factors that include immunosuppression and pregnancy.[18] Furthermore, Listeria septicemia during pregnancy is associated with an extremely high rate of premature labor and/or fetal demise.[19]

The issue of immunosuppression during pregnancy has been addressed elsewhere.[20] The large number of successful deliveries in patients who have undergone renal transplantation then maintained on immunosuppressive therapy tends to support the safety of pregnancy in this setting.[21] Deliveries after both hepatic[22] and bone marrow[23] transplantation have also been reported, without any ill effects attributed to immunosuppression.

In summary, we describe management of a patient in whom peripartum cardiomyopathy initially successfully treated with cardiac transplantation, was followed by elective cesarean delivery under epidural anesthesia 6 yr later during a pregnancy complicated by Listeria septicemia. Anesthetic management is described, particularly a possible exaggerated response to epidurally injected epinephrine.

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