

---

**CHAPTER 2**



**V O L U M E   T H I R T Y - S I X**

*MANAGEMENT OF THE  
PARTURIENT WITH  
CARDIOVASCULAR DISEASE*

**LISA M. COUNCILMAN, M.D.**

ASSISTANT PROFESSOR  
DEPARTMENT OF ANESTHESIOLOGY  
TEXAS A&M HEALTH SCIENCE CENTER COLLEGE OF MEDICINE  
TEMPLE, TEXAS

*EDITOR: MEG A. ROSENBLATT, M.D.*

*ASSOCIATE EDITORS: JOHN F. BUTTERWORTH IV, M.D.  
JEFFREY B. GROSS, M.D.*

The American Society of Anesthesiologists, Inc.

---

## ***The ASA Refresher Courses in Anesthesiology CME Program***

Beginning with Volume 35, 2007, purchasers of the *ASA Refresher Courses in Anesthesiology* series are eligible to earn CME credits from the American Society of Anesthesiologists. Please visit [www.asa-refresher-cme.asahq.org](http://www.asa-refresher-cme.asahq.org) or see page iv at the beginning of this volume for complete details.

### **Accreditation and Designation Statement**

The American Society of Anesthesiologists is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

The American Society of Anesthesiologists designates this educational activity for a maximum of 1 *AMA PRA Category 1 Credit*<sup>™</sup>. Physicians should only claim credit commensurate with the extent of their participation in the activity. Credit may be claimed in .25 hour increments to a maximum of 1.00 hour.

### **Author Disclosure Information**

Dr. Councilman has disclosed that she has no financial interests in or significant relationship with any commercial companies pertaining to this educational activity.

© 2008

The American Society of Anesthesiologists, Inc.

ISSN 0363-471X

ISBN 978-0-7817-8953-0

*An educational service to the profession under the auspices of  
The American Society of Anesthesiologists, Inc.*

*Published for The Society  
by Lippincott Williams & Wilkins  
530 Walnut Street  
Philadelphia, Pennsylvania 19106-3621  
Library of Congress  
Catalog Number 74-18961.*

[www.asa-refresher.com](http://www.asa-refresher.com)

PERMISSION TO PHOTOCOPY ARTICLES: This publication is protected by copyright. Permission to reproduce copies of articles for noncommercial use must be obtained from the Copyright Clearance Center, 222 Rosewood Dr., Danvers, MA 01923; (978) 750-8400, FAX: (978) 750-4470, [www.copyright.com](http://www.copyright.com).

# Management of the Parturient With Cardiovascular Disease

**Lisa M. Councilman, M.D.**

Assistant Professor

Department of Anesthesiology

Texas A&M Health Science Center College of Medicine

Temple, Texas

The incidence of clinically significant cardiac disease in the pregnant population ranges from 0.1 to 4%, which has not changed in decades; however, the most frequently seen etiology is now congenital heart disease (70 to 80%)<sup>1</sup> resulting from advances in surgical techniques for these patients and advances in medical therapy, allowing these women to survive into childbearing age. Ischemic heart disease is also seen more commonly today as a result of both the increasing number of women of advanced maternal age who are electing to undergo pregnancy and childbirth and advances in medical therapy for this condition. Although the incidence of cardiac disease in pregnant patients has remained relatively unchanged, the maternal mortality from cardiac disease has decreased from 6% in the 1930s to 0.5 to 2.7% today.<sup>1</sup> Unfortunately, pregnancy increases the maternal mortality risk in patients with cardiac disease when compared with the general population with the actual risk depending on the underlying cardiac disease process.<sup>1</sup> Taking the altered physiological processes into account, women with congenital heart disease and those with a history of ischemic heart disease require special attention and possibly altered approaches to the anesthetic plans for labor analgesia and/or cesarean section.

In the United States between 1991 and 1999, 34% of maternal deaths that were attributable to medical conditions other than embolism, hemorrhage, and pregnancy-induced hypertension (the leading causes of death) were from cardiovascular problems.<sup>2</sup> During this same time, the percentage of maternal deaths attributable to cardiomyopathy increased from 6 to 9%.<sup>2</sup> Seventy percent of maternal deaths from cardiomyopathy between 1991 and 1997 were from peripartum cardiomyopathy (PPCM), a form of dilated cardiomyopathy.<sup>3</sup> PPCM may present itself unexpectedly in the otherwise healthy parturient and may quickly become life-threatening with exceedingly high rates of morbidity and mortality. Early recognition of the signs and symptoms of PPCM is critical with rapid diagnosis and treatment crucial. Even in the best of circumstances, maternal mortality is a very real concern in the presence of PPCM.

## Congenital Heart Disease

Congenital heart disease is now the major etiology of cardiac disease in pregnant women in the United States.<sup>4</sup> Many more women with congenital heart disease are now reaching childbearing age, giving rise to the need for novel approaches to labor analgesia and anesthesia for cesarean section in this high-risk population. Many of the women with congenital heart disease have undergone successful surgery to correct the defects; however, some women may present with uncorrected or only partially corrected lesions.<sup>4</sup> Management of these patients may present some interesting challenges for both the obstetrician and the anesthesiologist.<sup>4</sup>

Patients with existing small left-to-right shunts often tolerate pregnancy quite well. This category of patients includes those with a small atrial septal defect, small ventricular septal defects, or patent ductus arteriosus. Anesthetic management of patients with left-to-right shunts needs to include attention to several important factors. Care must be taken to remove all air bubbles from the intravenous tubing to avoid systemic air embolization and epidural needle placement should be performed using a loss of resistance to saline rather than air to avoid systemic air emboli.<sup>4</sup> Epidural anesthesia is preferred over general anesthesia in these patients to avoid pulmonary hypertension and right heart failure that can occur with an increase in the left-to-right shunt fraction. Increased shunting may be seen with the increased maternal systemic vascular resistance (SVR) that occurs with increased maternal catecholamine production in response to pain during contractions.<sup>4</sup> Early epidural analgesia may help to blunt this response by preventing the initial increase in catecholamine secretion.<sup>4</sup> The epidural must be titrated slowly to prevent a rapid decrease in SVR, which could reverse the shunt and cause maternal hypoxemia.<sup>4</sup> Maneuvers to prevent an increase in pulmonary vascular resistance should be implemented such as providing supplemental oxygen and avoiding hypercarbia and acidosis. An increase in pulmonary vascular resistance may lead to a reversal of the shunt, forming a right-to-left shunt that will lead to worsening of the hypoxemia.<sup>4</sup>

Tetralogy of Fallot accounts for 5% of congenital heart disease in pregnant women.<sup>4,5</sup> The uncorrected lesions produce a right-to-left shunt that leads to cyanosis. Most patients will have undergone definitive surgical correction before their pregnancy but may have various anatomic and physiological alterations that must be recognized such as right ventricular dysfunction, pulmonary stenosis and/or regurgitation, and both atrial and ventricular dysrhythmias.<sup>4-6</sup> These anatomic and physiological alterations may present themselves symptomatically during pregnancy as the cardiovascular changes of pregnancy progress. Although these women may appear healthy, they are still considered a high-risk group of parturients. Patients with a tetralogy of Fallot repair should have echocardiograms performed before and during pregnancy.<sup>4</sup> Anesthesia for asymptomatic patients with a definitive tetralogy of Fallot repair will most likely not differ from those patients without this condition with the exception of the need for an antepartum 12-lead electrocardiogram and continuous electrocardiogram monitoring during labor and delivery.<sup>4,6</sup> Fernandez and Kuczkowski describe the safe use of spinal anesthesia for cesarean delivery in a patient with a corrected tetralogy of Fallot.<sup>6</sup> Patients with uncorrected or partially corrected tetralogy of Fallot require much greater attention. It is important to maintain adequate intravascular volume, venous return, and high right ventricular filling pressures in these patients to ensure adequate right ventricular filling and pulmonary blood flow.<sup>7</sup> Effective labor analgesia is important to prevent exacerbations of the right-to-left shunt as a result of an increase in pulmonary vascular resistance, as seen with pulmonary hypertension, right ventricular dysfunction, and cyanotic shunting.<sup>5</sup> Regional anesthesia containing local anesthetics must be used with extreme caution in these patients, because the decrease in SVR associated with the administration of neuraxial local anesthetic will worsen the right-to-left shunt, leading to hypoxemia.<sup>4</sup> A single-shot spinal anesthetic for cesarean section is relatively contraindicated because a precipitous decrease in SVR from the local anesthetic may lead to a worsening of the right-to-left shunt and progressive hypoxemia.<sup>5</sup>

Coarctation of the aorta is a congenital lesion more common in males than females and does not require any special anesthetic management for labor and delivery if surgically corrected.<sup>4,8</sup> Having an uncorrected coarctation of the aorta during pregnancy

places the patient at risk for left ventricular failure, aortic rupture or dissection, and endocarditis.<sup>4</sup> Aortic rupture is more likely to occur during the third trimester.<sup>1,9</sup> The added stress of the physiological changes of pregnancy result in a maternal mortality rate of 3% in patients with an uncorrected aortic coarctation.<sup>1,9</sup> These patients have a fixed obstruction to aortic outflow and distal hypoperfusion manifested by a difference between left-sided and right-sided blood pressures, upper extremity and lower extremity blood pressures, and may present with hypertension of an unknown etiology.<sup>4,5</sup> Hypotension will compromise not only the maternal myocardium, but also the placental blood flow to the fetus.<sup>9</sup> The hemodynamic goals in the patient with an uncorrected aortic coarctation include maintaining normal to slightly elevated SVR, normal to slightly increased heart rate, and adequate intravascular volume, with invasive blood pressure monitoring being helpful.<sup>4,5</sup> Postductal arterial blood pressure (left radial) may be a better indicator of uterine perfusion pressure than preductal arterial blood pressure (right radial).<sup>4,5</sup> Postductal systolic blood pressure should be maintained greater than 100 mmHg to avoid compromising uterine blood flow.<sup>8</sup> Neuraxial anesthesia for labor should be administered with great caution because neuraxial local anesthetic agents lead to a decrease in SVR, which can be devastating for both the mother and fetus.<sup>7</sup> Fetal mortality approaches 20% as a result of the inability to provide adequate uterine perfusion.<sup>7</sup> General anesthesia is recommended for cesarean section<sup>4</sup>; however, several reports in the literature describe the safe use of epidural and combined spinal-epidural techniques for cesarean section in patients with aortic coarctation both with and without prior palliative surgery.<sup>8,9</sup> Remifentanyl has been used successfully for general anesthesia in parturients with aortic coarctation, facilitating the maintenance of hemodynamic stability with minimal neonatal respiratory depression.<sup>4,5</sup> Ephedrine and dopamine are the vasopressors of choice in patients with uncorrected aortic coarctation because of their ability to maintain SVR and heart rate.<sup>4,5,7</sup>

## Ischemic Heart Disease

The incidence of myocardial infarction (MI) during pregnancy is on the rise because more women with multiple risk factors for ischemic heart disease are becoming pregnant.<sup>5</sup> The incidence is now estimated at 1 in 10,000 deliveries, accounting for nearly 2,000 deaths annually in women younger than age 45 years.<sup>4,5</sup> Risk factors for ischemic heart disease in parturients include: 1) increasing maternal age, because the number of women finishing their education or beginning their careers before starting a family is on the rise; 2) increasing number of smokers; 3) increasing incidence of cocaine use in women of childbearing age; 4) experiencing stress in the workplace; 5) oral contraceptive use after the age of 35 years; and 6) increased prevalence of type II diabetes.<sup>1,4,5,10</sup> The maternal mortality rate of a peripartum MI is 19% with a perinatal mortality rate of 17%.<sup>4</sup> If the MI occurs within 2 weeks of delivery, mortality may be as high as 45 to 50%.<sup>10,11</sup>

Myocardial ischemia during pregnancy may be attributable more to coronary vasospasm than to coronary artery disease.<sup>1</sup> Coronary atherosclerosis is found in less than half of patients who develop an MI during pregnancy.<sup>5</sup> Other etiologies of myocardial ischemia include coronary artery injury from vasospasm, dissection, aneurysm, or hematoma; severe hypertension from pregnancy-induced hypertension, pheochromocytoma, or cocaine use; severe tachycardia in patients with left ventricular hypertrophy, hypotension, and anemia; and severe aortic stenosis.<sup>4,5</sup> Kulka *et al.* describe a 31-year-old patient who developed an MI after induction of spinal anesthesia for a

cesarean section after aggressive treatment of hypotension led to significant hypertension and tachycardia.<sup>12</sup> Coronary angiography in that patient revealed normal coronary vessels; however, intravascular ultrasound demonstrated an atheroma in the left main coronary artery with a ruptured fibrous cap.<sup>12</sup>

Diagnosing myocardial ischemia in the pregnant patient may be difficult because the symptoms of ischemia mimic complaints in the normal pregnant patient. These presenting complaints may include dyspnea, diaphoresis, poor exercise tolerance, chest pain, and syncope. Electrocardiogram changes seen in myocardial ischemia mimic electrocardiogram changes that occur in normal pregnancy, including sinus tachycardia, a left axis deviation, ST segment depression, flattened or inverted T waves, and a Q wave in lead III, making a diagnosis of myocardial ischemia by electrocardiogram difficult.<sup>4</sup>

The anesthetic management of patients who have experienced an MI during pregnancy is challenging, requiring careful control of cardiovascular parameters using invasive monitoring and optimizing the myocardial oxygen supply-to-demand ratio. Supplemental oxygen should be provided throughout labor and delivery.<sup>4,5</sup> Tachycardia both decreases the oxygen supply to the myocardium and increases the oxygen demand and should be prevented or aggressively treated with adequate pain control and  $\beta$ -adrenergic antagonists as necessary. Neuraxial anesthesia, if no contraindications exist, will provide excellent pain relief, prevent hyperventilation, and reduce maternal concentrations of catecholamines, the goal of which is to prevent coronary artery vasoconstriction.<sup>4,11</sup> A dense epidural block for labor analgesia has the benefits of providing excellent pain relief during the first stage of labor, minimizing the maternal expulsive efforts during the second stage of labor (which otherwise greatly increases myocardial oxygen demand) and allowing for a comfortable forceps-assisted delivery, and allowing the rapid extension of anesthesia should the need arise for an urgent or emergent cesarean section.<sup>4,5</sup> Epinephrine is avoided in the epidural test dose and anesthetic solutions to avoid hypertension and tachycardia if inadvertent intravascular injection occurs. Phenylephrine is the vasopressor of choice for maternal hypotension in patients with ischemic heart disease.<sup>4</sup> Ephedrine should be avoided because of the tachycardia it produces is undesirable in patients at risk for myocardial ischemia.

If the patient with ischemic heart disease requires a cesarean section, care must be taken during taking the history and performing the physical examination to document all medications and treatments the patient has received during the pregnancy. Drug-eluting stents have been used in parturients with critical coronary heart disease. These particular stents require the patient to be placed on combination clopidogrel and aspirin therapy, and the patient cannot discontinue use of these medications for a period of at least 3 to 6 months and possibly 1 year or more, depending on the type of stent placed. Concomitant or recent use of anticoagulants or antiplatelet drugs impacts the anesthetic options available for patients in labor or requiring a cesarean section, possibly contraindicating neuraxial anesthesia.<sup>10</sup> Neuraxial anesthesia is absolutely contraindicated with an ongoing medication regimen of clopidogrel and aspirin. Intravenous opioids for labor and general anesthesia for a cesarean section are the extent of options available in patients currently anticoagulated.<sup>13</sup> Cuthill *et al.* describe such a case of a parturient who received a sirolimus-eluting stent for severe ostial left main coronary artery stenosis.<sup>13</sup> The patient was placed on combination anticoagulant therapy consisting of clopidogrel, aspirin, and enoxaparin and labetalol was prescribed.<sup>13</sup> A nitroglycerine patch was applied preoperatively and general anesthesia was performed for her cesarean section without any adverse events using an arterial line and central venous catheter for intraoperative hemodynamic monitoring.<sup>13</sup>



## Peripartum Cardiomyopathy

Peripartum cardiomyopathy is an idiopathic cardiomyopathy that has an onset during a 6-month timeframe, including the last month of pregnancy until 5 months postpartum.<sup>3,5,14</sup> Pre-existing heart disease must be excluded, no determinable etiology can be present, and echocardiographic criteria must be met, including a dilated cardiomyopathy with a decreased ejection fraction of less than 45% or a fractional shortening of less than 30%, and a left ventricular end-diastolic dimension of greater than 2.7 cm/m<sup>2</sup>.<sup>3,5,14</sup> Initial presenting symptoms may be limited to symptoms of a mild upper respiratory infection, including dyspnea, chest congestion, palpitations, and fatigue.<sup>4,5,14</sup> These early symptoms may mimic the normal changes seen with pregnancy and may be difficult to distinguish as abnormal. These symptoms may rapidly progress to florid cardiac failure with global hypokinesis, low cardiac output, elevated filling pressures, and ventricular ectopy.<sup>4</sup> Fussell *et al.* describe a 5-week postpartum patient who presented with fulminant hepatic failure 1 week after becoming symptomatic from an unrecognized PPCM.<sup>15</sup>

PPCM is a significant cause of maternal morbidity and mortality with the mortality or cardiac transplantation rate ranging between 12 and 18%.<sup>5</sup> Recent studies have shown a 5-year survival rate of 94%, of which 50% of these women will have complete or near-complete recovery of ventricular function.<sup>4</sup> Women with a history of PPCM and normal systolic function will have a relapse rate of 20% with a subsequent pregnancy, whereas women with a history of PPCM and residual left ventricular dysfunction have a relapse rate of 50% and a mortality rate of 8 to 17%.<sup>4,5</sup> Sliwa *et al.* followed six patients through subsequent pregnancies after having had PPCM with their prior pregnancy.<sup>16</sup> They found a reduction in the ejection fraction by greater than 10% in five of the six patients at 1 month postpartum, and two of the five women who had impaired left ventricular function at the onset of pregnancy died within 3 months postpartum despite optimal medical therapy, confirming that mortality during subsequent pregnancies is high, especially in patients with persistent left ventricular dysfunction after the prior pregnancy.<sup>16</sup> Whitehead *et al.* reviewed 171 deaths related to PPCM from 1991 through 1997 and noted that black women were 6.4 times as likely to die from PPCM as white women, and women 35 years of age and older had a risk of death 2.8 times greater than that of women aged 19 years old and younger.<sup>17</sup> Other risk factors for increased mortality from PPCM noted in their study included twin or greater gestations and parity greater than three.<sup>17</sup>

Medical management in the parturient with PPCM does not differ from the management of other patients with severe cardiomyopathy. Diuretics, vasodilators, and digoxin, as needed, should be initiated with careful attention paid to fetal safety and to excretion of the drug or its metabolites in breast milk.<sup>18</sup> Hydralazine and nitrates are safe alternatives during pregnancy.<sup>14,18,19</sup> Angiotensin-converting enzyme inhibitors, although contraindicated during pregnancy because of teratogenicity, should be considered a mainstay of postpartum treatment.<sup>18,19</sup> Amlodipine may have a role in the treatment of PPCM because it has been shown to improve survival in patients with nonischemic cardiomyopathy.<sup>18</sup>  $\beta$ -adrenergic antagonists may be used in the postpartum period in patients who have been refractory to other therapy and continue to have left ventricular dysfunction for more than 2 weeks after standard heart failure therapy.<sup>18</sup> Thrombo-embolic events are not uncommon; therefore, anticoagulation may be necessary.<sup>19</sup> Rarely, patients with PPCM fail medical therapy and require an intra-aortic balloon pump or ventricular-assist device for cardiovascular support.<sup>14</sup> These mechanical devices are considered a bridge until cardiac transplantation is able to be

performed in suitable transplant candidates.<sup>14,20</sup> The survival after cardiac transplant for PPCM is 75% at 4 years and does not differ from the survival rate of women who undergo cardiac transplantation for other forms of cardiomyopathy.<sup>14</sup>

Anesthetic management for the parturient with PPCM is not significantly different from that of other patients with a severe cardiomyopathy. Invasive monitoring is warranted in the acute setting until cardiac function has stabilized. Coagulation status should be normalized before the performance of neuraxial anesthesia. Cesarean sections have been performed safely in parturients with PPCM using both general and regional anesthesia techniques. Continuous neuraxial anesthesia is usually preferred because it decreases preload and afterload but not contractility, improving myocardial performance and reducing myocardial work.<sup>5</sup> Velickovic and Leicht describe the successful use of continuous spinal anesthesia in a parturient with severe recurrent PPCM.<sup>21</sup> When general anesthesia is necessary, extreme caution must be exercised to use drugs that do not depress the myocardium, because they could precipitate cardiac arrest and death.<sup>5</sup> A propofol and remifentanyl combination has been described for use in general anesthesia for cesarean section in a patient with PPCM, providing good cardiovascular stability throughout the procedure.<sup>22</sup>

## Conclusion

Encountering a patient with cardiovascular disease in the labor and delivery unit can be a harrowing experience. The patient's likelihood of developing complications, including, death is increased, something that is not frequently encountered in most labor and delivery units. However, understanding the underlying physiological processes will assist the anesthesiologist in the preparation and delivery of safe anesthetic care for the parturient with cardiovascular disease. Invasive monitoring may be warranted and slowly titrated neuraxial analgesia or anesthesia may be prudent; however, certain cardiac conditions mandate general anesthesia. In any event, preparedness and vigilance, as well as good communication with the obstetricians, are paramount for the safe management of the parturient with cardiovascular disease.

## References

1. Van Mook WNKA, Peeters L: Severe cardiac disease in pregnancy, part II: Impact of congenital and acquired cardiac diseases during pregnancy. *Curr Opin Crit Care* 2005; 11:435-48.
2. Chang J, Elam-Evans LD, Berg CJ, *et al.*: Pregnancy-related mortality surveillance—United States, 1991-1999. *MMWR Surveill Summ* 2003; 52:1-8.
3. Pryn A, Bryden F, Reeve W, *et al.*: Cardiomyopathy in pregnancy and cesarean section: Four case reports. *Int J Obstet Anesth* 2007; 16:68-73.
4. Harnett MB, Mushlin PS, Camann WR: Cardiovascular disease. *Obstetric Anesthesia Principles and Practice*. 3rd ed. Edited by Chestnut DH. Philadelphia, Elsevier Mosby, 2004, pp 707-29.
5. Mushlin PS, Davidson KM: Cardiovascular disease in pregnancy. *Anesthetic and Obstetric Management of High-Risk Pregnancy*. 3rd ed. Edited by Datta SJ. New York, Springer-Verlag, 2004, pp 155-95.
6. Fernandez CL, Kuczkowski KM: Once a tetralogy of Fallot patient—Always a tetralogy of Fallot patient(?): Time for reconsideration? *Annales Francaises d' Anesthesie et de Reanimation* 2004; 23:1107-8.
7. Tsen LC: Anesthetic management of the parturient with cardiac and diabetic diseases. *Clin Obstet Gynecol* 2003; 46:700-10.
8. Walker E, Malins AF: Anesthetic management of aortic coarctation in pregnancy. *Int J Obstet Anesth* 2004; 13:266-70.



9. Togal T, Durmus M, Koroglu A, *et al.*: Anesthesia for cesarean section in the presence of aortic coarctation. *Eur J Anesthesiol* 2002; 19:768-70.
10. Ray P, Murphy GJ, Shutt LE: Recognition and management of maternal cardiac disease in pregnancy. *Br J Anaesth* 2004; 93:428-39.
11. Rout CC: Anesthesia and analgesia for the critically ill parturient. *Best Pract Res Clin Obstet Gynaecol* 2001; 15:507-22.
12. Kulka PJ, Scheu C, Tryba M, *et al.*: Coronary artery plaque disruption as cause of acute myocardial infarction during cesarean section with spinal anesthesia. *J Clin Anesth* 2000; 12: 335-8.
13. Cuthill JA, Young S, Greer IA, *et al.*: Anaesthetic considerations in a parturient with critical coronary artery disease and a drug-eluting stent presenting for cesarean section. *Int J Obstet Anesth* 2005; 14:167-71.
14. Tidswell M: Peripartum cardiomyopathy. *Crit Care Clin* 2004; 20:777-88.
15. Fussell KM, Awad JA, Ware LB: Case of fulminant hepatic failure due to unrecognized peripartum cardiomyopathy. *Crit Care Med* 2005; 33:891-3.
16. Sliwa K, Forster O, Zhanje F, *et al.*: Outcome of subsequent pregnancy in patients with documented peripartum cardiomyopathy. *Am J Cardiol* 2004; 93:1441-3.
17. Whitehead SJ, Berg CJ, Chang J: Pregnancy-related mortality due to cardiomyopathy: United States, 1991-1997. *Obstet Gynecol* 2003; 102:1326-31.
18. Pearson GD, Veille JC, Rahimtoola S, *et al.*: Peripartum Cardiomyopathy, National Heart, Lung, and Blood Institute and Office of Rare Diseases (National Institutes of Health) Workshop recommendations and review. *JAMA* 2000; 283:1183-8.
19. Murali S, Baldisseri MR: Peripartum cardiomyopathy. *Crit Care Med* 2005; 33(Suppl):S340-6.
20. Monta O, Matsumiya G, Fukushima N, *et al.*: Mechanical ventricular assist system required for sustained severe cardiac dysfunction secondary to peripartum cardiomyopathy. *Circ J* 2005; 69:362-4.
21. Velickovic IA, Leicht CH: Continuous spinal anesthesia for cesarean section in a parturient with severe recurrent peripartum cardiomyopathy. *Int J Obstet Anesth* 2004; 13:40-3.
22. McCarroll CP, Paxton LD, Elliott P, *et al.*: Use of remifentanyl in a patient with peripartum cardiomyopathy requiring cesarean section. *Br J Anesth* 2001; 86:135-8.



## REPRINTS

Authors may order print or electronic reprints of their own articles (minimum order of 100 copies) using the order form posted to the publication's website at [www.asa-refresher.com](http://www.asa-refresher.com), or contact: Author Reprints Department, Lippincott Williams & Wilkins, 351 West Camden Street, Baltimore, MD 21201; fax 410-528-4434; e-mail [reprints@lww.com](mailto:reprints@lww.com). For all other bulk purchases, please contact Matt Westcoat ([Matt.Westcoat@wolterskluwer.com](mailto:Matt.Westcoat@wolterskluwer.com)) in North America, Carlos Moreyra ([Carlos.Moreyra@wkglobal.com](mailto:Carlos.Moreyra@wkglobal.com)) in Latin America, and Christopher Bassett ([Christopher.Bassett@wolterskluwer.com](mailto:Christopher.Bassett@wolterskluwer.com)) in Europe and elsewhere.

## SUBSCRIPTION

Annual subscription rate: individual rate is \$55.00 and institutional rate is \$74.00; residents pay \$34.00. Subscriptions outside of North America must add \$13.00 for airfreight delivery. Add state sales tax, where applicable. The GST of 7% must be added to all orders shipped to Canada (Lippincott Williams & Wilkins GST Identification #895524239, Publications Mail Agreement #1119672). Indicate in-training status and name of institution. Institutional rates apply to libraries, hospitals, corporations, and partnerships of three or more individuals. Subscription orders outside the United States must be prepaid. Prices subject to change without notice. Visit us online at [www.lww.com](http://www.lww.com).

For subscription information, orders, or changes of address, write to Lippincott Williams & Wilkins, 16522 Hunters Green Parkway, Hagerstown, MD 21740-2116, or call 1-800-638-3030 (outside the United States 301-223-2300/+44 (0) 20 7981 0525); fax: 301-223-2400/+44 (0) 20 7981 0535; email: [customer-service@lww.com](mailto:customer-service@lww.com). Correspondence regarding subscriptions in Japan, including inquiries about subscription rates and orders, should be sent to Wolters Kluwer Health Japan Co., Ltd, Shoei-Bldg 7F, 3-23-14 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan; phone: 81-3-5689-5400; fax: 81-3-5689-5402; email: [journal@wkhjapan.co.jp](mailto:journal@wkhjapan.co.jp). In Bangladesh, India, Nepal, Pakistan, and Sri Lanka, contact Globe Publication Pvt. Ltd., B-13 3rd Floor, A Block, Shopping Complex, Naraina, Vihar, Ring Road, New Delhi 1100228, India; phone: 91-11-25770411; fax: 91-11-25778876; email: [info@globepub.com](mailto:info@globepub.com).

Individual and resident rates include print and access to the online version. Institutional rates are for print only; online subscriptions are available via Ovid. Please contact the Ovid Regional Sales Office near you or visit [www.ovid.com/site/index.jsp](http://www.ovid.com/site/index.jsp) and select Contact and Locations.

Statements or opinions expressed in the *ASA Refresher Courses in Anesthesiology* reflect the views of the author(s) and do not represent official policy of the American Society of Anesthesiologists unless so stated.

The authors and publisher have exerted every effort to ensure that drug selection and dosage set forth in this text are in accord with current recommendations and practice at the time of publication. However, in view of ongoing research, changes in government regulations, and the constant flow of information relating to drug therapy and drug reactions, the reader is urged to check the package insert for each drug for any change in indications and dosage and for added warnings and precautions. This is particularly important when the recommended agent is a new or infrequently employed drug.

