High-Risk Pregnancy: Maternal Comorbidity

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Modern medicine has increased the longevity as well as the functional status of women who have systemic diseases. This has resulted in many women reaching childbearing age with successful pregnancies. In vitro fertilization has its own impact in this phenomenon. The end result is a steady increase in the number of women requiring high-risk obstetric and anesthetic care to successfully maneuver these individuals through pregnancy, labor, and delivery. This chapter will focus on pathophysiology of various comorbid conditions one might encounter during obstetric anesthetic practice, and how it influences the anesthetic management.

**Endocrine Disorders**

**Diabetes Mellitus**

The major problems encountered in diabetic pregnancy are as follows:
1. Placental insufficiency
2. Superimposed preeclampsia
3. Diabetic nephropathy
4. Diabetic ketoacidosis is the main factor in the increased incidence of perinatal morbidity and mortality. Evidence exists that ketones can readily cross the placenta, and this can significantly decrease fetal oxygenation. Biochemical findings include a plasma glucose level greater than 300 mg/dL, plasma HCO₃ less than 15 mEq/L, arterial pH less than 7.30, and serum acetone positive at 1:2. The treatment of diabetic ketoacidosis should include enough insulin to correct the acidosis and to carefully balance the fluid, glucose, and electrolyte levels. Continuous fetal heart rate monitoring should be instituted for fetal surveillance.
Pathophysiological Changes

The anesthetic management of diabetic parturients should be based on the understanding of pathophysiological changes associated with diabetic pregnancy.

**Deranged Uteroplacental Blood Flow.** Maternal diabetes is associated with placental abnormalities even in the case of mild, well-controlled gestational diabetes. The uteroplacental blood flow index is reduced 35–45% in diabetic parturients. The blood flow index tends to be further impaired in those diabetic women who have higher blood glucose values.\(^1\)

**Impairment of Oxygen Transport in Diabetes.** HbA\(_{1c}\) (a minor variant of hemoglobin A) levels are two to three times higher in insulin-treated diabetics than in control subjects. In contrast to hemoglobin A, the oxygen affinity of HbA\(_{1c}\) is little affected by the in vitro addition of 2,3-diphosphoglycerate (2,3-DPG). It has been observed that red blood cell oxygen transport, saturation, and tension are impaired in insulin-dependent diabetic subjects. In poorly regulated women, in whom the concentrations of HbA\(_{1c}\) are higher and the concentrations of 2,3-DPG tend to be lower, the blood oxygen release at the tissue level may be more impaired\(^2\) (Figs. 14-1 and 14-2).

![Graph](image)

**Figure 14–1.** Correlation between HbA\(_{1c}\) and \(P_{50}\) at actual pH in diabetic women. (Adapted from Madsen and Ditzel.\(^2\))
Deranged Buffering Capacity in Infants of Diabetic Mothers. Broulliard et al. observed an interesting phenomenon suggesting that infants of diabetic mothers have a decreased buffering capacity and a different response to an increased acid load. There is an increased affinity of hemoglobin to oxygen in infants of diabetic mothers. The $P_{50}$ (torr) values were significantly less in infants of diabetic mothers when compared with control infants (17.9 vs. 22.6).\(^3\) This multiplicity of problems makes infants of diabetic mothers more vulnerable to hypoxia.

Placental Transfer of Insulin. It has been shown that insulin could cross the placenta from the maternal to the fetal circulation as insulin–anti-insulin antibody complexes.\(^4\) This must be taken into consideration in the management of blood sugars in the diabetic parturients.
Anesthetic Management

Labor and Delivery. For labor and vaginal delivery moderate pain relief can be obtained by administering small doses of narcotics early in the first stage. A lumbar epidural block can provide excellent pain relief for both labor and delivery. It has been noted that the fetus entered the second stage in a less acidotic state when mothers received epidural analgesia compared to fetuses whose mothers did not receive any analgesia.5 The acidosis was metabolic in origin and was related to high lactate concentrations. One report suggested that epidural analgesia will reduce the level of maternal endogenous catecholamines during labor, and this might benefit placental perfusion, a factor possibly more important in this particular group of parturients.6

Spinal anesthesia (bupivacaine 2.5–3 mg, fentanyl 25–30 μg) can also be used if required at the time of delivery. One should use a separate intravenous line for the rapid infusion of non-dextrose-containing solutions if necessary to treat hypotension without producing hyperglycemia. It is also important to realize that the fetus of a diabetic mother might be quite susceptible to hypoxia secondary to maternal hypotension.

Anesthesia for Cesarean Section. The incidence of cardiovascular depression is higher during regional anesthesia for cesarean section and is related to a higher sympathetic blockade accentuated by compression of the inferior vena cava and aorta by the gravid uterus.

Datta et al. compared spinal and general anesthesia for abdominal delivery in healthy mothers and diabetic parturients. They found that infants of diabetic mothers receiving spinal anesthesia were more acidotic than infants of diabetic mothers receiving general anesthesia.7 The acidosis appeared to be related to both maternal diabetes and maternal hypotension. Subsequently, maternal and neonatal acid–base values were also examined by Datta et al. after administering epidural anesthesia.8 They observed a 60% incidence of neonatal acidosis (umbilical artery pH of 7.20 or less) during epidural anesthesia.8 The fetal acidosis was related to both the degree and the presence of maternal hypotension. The umbilical artery pH was always greater than 7.20 in the absence of maternal
Table 14–1. Effect of Hypotension in Infants of Diabetic Mothers Following Spinal or Epidural Anesthesia for Cesarean Section

<table>
<thead>
<tr>
<th>Anesthesia</th>
<th>No Hypotension</th>
<th>Hypotension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umbilical artery pH</td>
<td>7.24 ± 0.02†</td>
<td>7.16 ± 0.01‡</td>
</tr>
<tr>
<td>PO₂ (mmHg)</td>
<td>19 ± 2</td>
<td>16 ± 2</td>
</tr>
<tr>
<td>PCO₂ (mmHg)</td>
<td>65 ± 3</td>
<td>71 ± 4‡</td>
</tr>
<tr>
<td>Base deficit (mEq/L)</td>
<td>4.35 ± 0.88 n=9</td>
<td>8.25 ± 1.74‡</td>
</tr>
</tbody>
</table>

Epidural anesthesia (N = 16)

| Umbilical artery pH | 7.26 ± 0.02 | 7.16 ± 0.01‡ |
| PO₂ (mmHg)          | 25 ± 2.5    | 18 ± 1.3‡   |
| PCO₂ (mmHg)         | 52 ± 2      | 65 ± 3†     |
| Base deficit (mEq/L)| 5 ± 1.2     | 10 ± 0.6‡   |

†Mean ± SE.
‡p, 0.05.
Data from Datta and Brown⁷; and Datta et al.⁸

hypotension (Table 14-1). Datta et al. used 5% dextrose with lactated Ringer’s solution for acute volume expansion in both studies.

The genesis of the fetal acidosis in pregnant diabetic parturients appears to be complex, and several factors might be involved: (1) the human placenta produces lactate in vitro, especially under conditions of hypoxia or increased glycogen deposition as in maternal diabetes, (2) fetal lactic acidemia might occur due to hypoxia (secondary to maternal hypotension) in the presence of hyperglycemia following acute volume loading with dextrose-containing solutions. An additional risk of maternal and fetal hyperglycemia accompanying acute volume expansion with dextrose-containing solutions before cesarean section in diabetic parturients is the occurrence of neonatal hypoglycemia. (3) Finally, it has been observed that chronic infusion of insulin directly into the sheep fetus increased fetal glucose uptake, increased oxidative utilization of glucose by the fetus, and surprisingly, reduced the fetal arterial oxygen content.⁹ Hyperinsulinemia may increase oxygen consumption. Fetal hyperglycemia and hyperinsulinemia might
result in reduced fetal oxygenation in pregnancies complicated by uncontrolled diabetes (Fig. 14-3).

In another study, Datta et al. re-evaluated the acid–base status (Table 14-2) of ten rigidly controlled insulin-dependent diabetic mothers and ten healthy nondiabetic control women having spinal anesthesia for cesarean section. The par- turients were all well controlled, dextrose-free intravenous solutions were used for volume expansion before induction of anesthesia, and hypotension was prevented in all cases by prompt treatment with ephedrine. There were no significant differences in the acid–base values between the diabetic and nondiabetic mothers and the infants of the diabetic and control groups. Datta et al. concluded that (1) if maternal diabetes is well controlled, (2) if dextrose-containing solutions are not used for maternal intravascular volume expansion before delivery, and (3) if maternal hypotension is avoided, regional anesthesia can be used safely for diabetic mothers having cesarean section. If general anesthesia is used, metoclopramide should be used preoperatively because the incidence of gastric stasis may be high in this group of women. Finally, one should also remember the significant decrease in insulin requirement immediately after delivery. Impaired counter-regulatory hormone responses to hypoglycemia during sleep have been also observed in diabetic subjects. Although no clinical study exists, one should speculate that the IDDM parturients may benefit from cesarean section under regional rather than general anesthesia due to less catecholamine surge during regional anesthesia as compared to general anesthesia.

In summary, the key points of anesthesia for cesarean section diabetic parturients are
1. Hydration using non-dextrose-containing solutions (separate intravenous line if necessary).
2. Routine left uterine displacement is used.
3. Hypotension is promptly treated with intravenous ephedrine.
4. A well-conducted general anesthesia can be used if necessary with good neonatal outcome.
Figure 14–3. Relationship between fetal plasma insulin concentration and (a) fetal arterial oxygen content, (b) fetal venous oxygen content, and (c) fetal umbilical venoarterial oxygen content difference. (From Milley et al.9 Used with permission from Elsevier.)
Table 14–2. Acid–Base Values in Infants of Diabetic Mothers with Rigid Glucose Control, Non-Dextrose-Containing Solution for Volume Expansion, and Prevention of Maternal Hypotension

<table>
<thead>
<tr>
<th>Umbilical Artery (n = 20)</th>
<th>No Hypotension (Diabetic) (n = 10)</th>
<th>No Hypotension (Control) (n = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.27 ± 0.01†</td>
<td>7.30 ± 0.01</td>
</tr>
<tr>
<td>PO₂ (mmHg)</td>
<td>20 ± 2</td>
<td>22 ± 2</td>
</tr>
<tr>
<td>PCO₂ (mmHg)</td>
<td>56 ± 2</td>
<td>50 ± 2.5</td>
</tr>
<tr>
<td>Base deficit (mEq/L)</td>
<td>4 ± 1</td>
<td>3 ± 0.7</td>
</tr>
</tbody>
</table>

†Values represent mean ± SE.
From Datta et al.10 Used by permission.

Hyperthyroidism

Major problems involving parturients with hyperthyroidism include the following:
1. The parturient might be receiving propranolol therapy.
2. If the mother is receiving antithyroid therapy, fetal goiter may occur.
3. The myocardium remains hypersensitive to catecholamines in such cases.
4. There is a possibility of thyroid storm. Thyroid storm, an exaggerated hypermetabolic state of thyrotoxicosis, is rare during pregnancy. Clinical signs include high fever, tachycardia, agitation, and severe dehydration. The important differential diagnosis is malignant hyperthermia.

Anesthetic Management

Regional anesthesia, especially spinal anesthesia, may be avoided, especially for cesarean delivery, if the mother is taking high doses of propranolol due to exaggerated post-spinal hypotension. Epidural anesthesia is a reasonable alternative to spinal anesthesia.
Pheochromocytoma

During pregnancy this entity carries high maternal and fetal mortality rates. Although epidural anesthesia can be used for labor and delivery, for cesarean section, an epidural or continuous spinal and general anesthesia may be used. Prior treatment with $\alpha$- followed by $\beta$-adrenergic blockers is indicated in elective cesarean section. Cases have been reported in which cesarean section was successfully performed under epidural analgesia in patients whose pregnancy was complicated by a pheochromocytoma. Pre-operative phenoxybenzamine therapy together with careful peri-operative monitoring produced cardiovascular stability. Occasionally, pheochromocytoma can mimic preeclampsia in pregnancy. Pheochromocytoma has been successfully removed during cesarean section after the delivery of the baby under combined regional and general anesthesia.

Cardiac Disease

Rheumatic fever-related acquired heart problems have decreased dramatically in recent years, and with better surgical technique, the future population will become pregnant with fewer congenital cardiac problems. However, the surgical corrective procedures performed pose a new challenge for obstetric anesthesiologists as they are required to understand the altered anatomical and physiological cardiovascular flow dynamics that have enabled the women to reach pregnancy state. The incidence of heart disease during pregnancy varies from 0.4% to 4.1%. Major cardiac problems can be divided into acquired, congenital, and surgically altered anatomical and physiological functions during corrective surgery for congenital lesions:

I. Acquired cardiac disease
   A. Mitral stenosis
   B. Mitral insufficiency
   C. Mitral valve prolapse
   D. Aortic stenosis
   E. Aortic insufficiency
II. Congenital cardiac disease
   A. Left-to-right shunt
      1. Ventricular septal defect
      2. Atrial septal defect
      3. Patent ductus arteriosus
   B. Right-to-left shunt
      1. Tetralogy of Fallot
      2. Eisenmenger’s syndrome
   C. Corrective surgical procedures altering anatomical and physiological function.

Patients with cardiac disease can be affected by some of the important physiological changes during pregnancy as well as during labor and delivery. An increase in cardiac output is the most important physiological change. Cardiac output maximally increases during pregnancy at 28–32 weeks of gestation, and labor and delivery can impose further stress. During the first stage of labor, cardiac output increases 15–30% because of autotransfusion (300–500 mL) during each uterine contraction, and due to increases in the heart rate due to the effect of catecholamines. During the second stage, cardiac output can increase further, and the highest cardiac output is observed immediately after delivery due to autotransfusion (potentially up to 80% above normal) (Fig. 14-4).

Some of the patients may be on anticoagulants for preventing thromboembolic phenomena. Heparin is usually the drug of choice (does not cross placenta), but oral anticoagulant therapy should be discontinued before the time of delivery to avoid potential fetal bleeding caused by the trauma of delivery. Parturients with cardiac lesions can be also receiving beta-blockers, digoxin, diuretics, etc.

Anesthetic Management

It is wiser to have the cardiologist monitor the cardiovascular status of pregnant women during the course of pregnancy and appropriate adjustments made in the therapeutic medications. Heparin treatment should be stopped before induction of labor or elective cesarean section, and the aPTT should be measured if regional analgesia/anesthesia is to be used.
Anesthetic management of cardiac disease in pregnancy can be summarized as shown in the outline below.

I. Acquired heart diseases:
   A. Labor and delivery:
      1. Relief of stress and apprehension should be accomplished during labor by the administration of tranquilizers.
      2. For relief of pain, epidural analgesia should be considered.
      3. Hypotension should be avoided by carefully administering fractionated doses of epidural local anesthetics. Aortocaval compression should be avoided. If there is hypotension, phenylephrine in dilute solution is preferable to ephedrine because ephedrine can increase the heart rate, which is not preferable in stenotic lesions. Fractionated boluses of intravenous fluids may be required to maintain adequate preload during enhancement of epidural blockade.
B. Cesarean section:
   1. Parturients with aortic insufficiency and mitral insufficiency can tolerate epidural anesthesia or the continuous spinal technique.
   2. Pregnant women with severe aortic stenosis or mitral stenosis need close and careful attention. Both regional anesthesia (epidural) and general anesthesia have been used. If general anesthesia is selected, then a high-dose narcotic technique is preferable.
   3. Depending upon the cardiovascular functional status, an arterial line to monitor blood pressure is a reasonable option. Occasionally, central line and PA catheters may be needed in a small subset of patients with either ventricular failure or pulmonary hypertension. Insertion of PA catheters has been a rarity in our institution where we provide care to several parturients with cardiac lesions. The functional status of the patient dictates the modus operandi rather than the anatomical lesions.

II. Congenital heart lesions:
   A. Labor and delivery:
      1. Hypotension will reverse the left-to-right shunt. For this reason, high sympathetic block should always be avoided.
      2. Epidural analgesia with proper invasive monitoring can be used for labor and delivery. This will be beneficial for complete relief of pain and abolition of bearing down, which might further increase the right atrial, right ventricular, and pulmonary pressures. Hypotension should be treated with small doses of phenylephrine. Recently, intrathecal narcotics have been used for maintaining cardiovascular stability.
      3. A combination of systemic analgesics and tranquilizers during the early first stage with a paracervical block during the active phase and a bilateral pudendal block during delivery can also be used. One must be aware of the problems associated with paracervical blocks, and continuous fetal monitoring is mandatory.
4. Regional anesthesia is contraindicated if anticoagulant treatment must be continued for any reason.

B. Cesarean section:

1. Epidural anesthesia has been used with invasive monitoring; postoperative analgesia can be used by the epidural route.

2. General anesthesia can be used with the high-dose narcotic technique. The newborn can be resuscitated appropriately.

3. A dilute oxytocin solution should be infused to prevent postpartum uterine relaxation and excessive blood loss. A bolus intravenous injection of oxytocin may cause serious hypotension, while intramuscular ergonovine preparations may produce severe peripheral vasoconstriction followed by hypertension. Both these drugs should be used carefully during cesarean delivery. In patients, where optimum fluid balance was achieved prior to labor and delivery by diuretics, further use of postpartum diuretics should be considered.

4. Parturients receiving propranolol are always at “greater risk” because anesthesiologists may face problems related to a reduction in cardiac output and maternal myocardial reserve, as well as decreased responsiveness to β-adrenergic-stimulating drugs in the presence of hypotension. Parturients receiving high doses of propranolol may not be candidates for major regional anesthesia for cesarean delivery. Despite this concern, a carefully administered epidural anesthesia is an option that can avoid general anesthetic. The effects of the chronic administration of propranolol on the fetus include intrauterine growth retardation, fetal bradycardia, and neonatal hypoglycemia, so babies need careful postpartum attention in such cases.

III. Surgical procedures altering anatomical and physiological function: Congenitally corrected transposition of the great arteries (CCTGA) is an uncommon congenital heart disease characterized by inversion of the ventricles resulting in
both atrioventricular (AV) and ventricular-great artery discordance. As a consequence, deoxygenated blood flows from the right atrium, through the left ventricle, and into the pulmonary artery (PA). In contrast, oxygenated blood flows from the left atrium, through the right ventricle, and into the aorta. Because the morphologic right ventricle and tricuspid valve are in the systemic circulation, most patients will develop systemic (morphologic right) ventricular dysfunction and varying degrees of systemic AV (morphologic tricuspid) valve regurgitation with increasing age. Similarly, the hemodynamic stress of pregnancy, labor, and delivery may also lead to ventricular failure and valvular dysfunction.

The cases of this type have been well managed with right radial arterial line and epidural anesthesia. Anesthesia was gradually achieved via incremental doses of bupivacaine with fentanyl. Varieties of shunting procedures are being performed in infants with cardiac anomalies. It is essential to understand the physiology of cardiovascular function in these individuals. A management strategy has to be evolved in conjunction with cardiologists. The vast experience at Brigham and Women’s Hospital demonstrates that the pregnant patients with shunting procedures do well with epidural anesthesia during labor and delivery.

The anesthetic management for cardiac disease can be summarized as follows:

A. The pregnant woman should be consulted at 24–32 weeks’ gestation because cardiac output is highest at this stage. The parturients can be classified into four groups according to New York Heart Association classification (Table 14-3).

B. Depending on the NYHA classification, one can decide the monitoring of the parturients:
   a. Invasive monitoring should include arterial line, CVP line with cordis, and PA catheter in rare cases.

C. Anesthetic management for labor and delivery may include early epidural analgesia. Sensory analgesia levels should be increased gradually, observing the mean arterial pressure and CVP, if present. A decrease in blood pressure should be treated with a judicious volume of fluid and vasopressors.
Table 14–3. New York Heart Association Functional Classification

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Asymptomatic</td>
</tr>
<tr>
<td>II</td>
<td>Symptomatic with exertion</td>
</tr>
<tr>
<td>III</td>
<td>Symptomatic with normal activities</td>
</tr>
<tr>
<td>IV</td>
<td>Symptomatic at rest</td>
</tr>
</tbody>
</table>

Phenylephrine in small doses (50–100 μg) should be used unless contraindicated, in which case ephedrine may be the drug of choice. Sensory levels should be maintained to T₆. For the second stage perineal anesthesia should be dense (cardiac delivery) to prevent the urge to push. Forceps or vacuum extraction is usually performed. If emergency cesarean section is necessary, the surgical anesthesia can be obtained using either with 2% plain lidocaine (lidocaine with epinephrine as the case may be) 0.5% ropivacaine or 0.5 bupivacaine mixed with opioids (fentanyl or sufentanil). If general anesthesia is deemed necessary, induction of anesthesia with opioids, or mixed with etomidate, will be the ideal choice. Remifentanil has been used recently for cesarean section in parturients with cardiac anomalies.¹⁸–²⁰ A single bolus of 1 μg/kg remifentanil effectively attenuated hemodynamic changes after induction and tracheal intubation. However, remifentanil crosses the placenta and may cause mild neonatal depression and thus should be used for definitive maternal indication and when adequate facilities for neonatal resuscitation are available.

Respiratory Problems

Bronchial Asthma

Bronchial asthma might be expected to improve during pregnancy due to the bronchiolar relaxing effect of progesterone. However, it has been shown that pregnancy has no consistent effect on the course of asthma. Medical therapy is the same as in nonpregnant women. For labor and delivery, one should use a continuous epidural block.
Cesarean Section

The possibility of drug interactions should be borne in mind when taking care of pregnant women with a history of bronchial asthma. Different medications that have been used are (1) methylxanthines, e.g., theophylline, aminophylline; (2) β-mimetic drugs, e.g., metaproterenol, albuterol (salbutamol), terbutaline, inhaled β-mimetic agonists (the primary medications for the treatment of acute asthma at the present time); and (3) corticosteroids.

Regional Anesthesia

Studies have suggested that although regional anesthesia has minor effects on inspiratory effort, its effect on expiratory function can be significant. Spinal anesthesia, because of its more intense motor block, can affect abdominal muscle function as well as cough strength, thus affecting expiratory function considerably. Severe bronchoconstriction following spinal anesthesia in a parturient with severe asthma has been reported. The author suggested that diminished epinephrine secretion from the adrenal medulla because of sympathectomy might have triggered the bronchospasm. Epidural anesthesia is preferred over spinal anesthesia as the regional anesthetic of choice in a parturient with severe asthma. The gradual onset of epidural anesthesia enables the parturient to tolerate intercostal muscle weakness without resulting in panic attacks. An interesting study observed less dense intercostal motor block with 0.5% bupivacaine compared to 2% lidocaine with epinephrine (this should be true for 0.5% ropivacaine).

General Anesthesia

General anesthesia should be avoided in parturients with respiratory problems if possible because the endotracheal tube can trigger severe bronchospasm. However, if it is absolutely essential, several precautions involving premedication should be taken: (1) H2-receptor blockers like cimetidine and ranitidine should be avoided because the H2-receptor blocka
can increase the sensitivity to histamine-induced bronchoconstriction; two (2) nonparticulate antacids, 0.3 M sodium citrate, 30 mL, should be used routinely; and (3) atropine and glycopyrrolate can reduce oral secretions and will also cause bronchodilatation; hence some anesthesiologists will use these drugs as a premedicant. However, these drugs can reduce gastroesophageal sphincter tone.

**Induction Agents.** Ketamine should be the drug of choice (in the presence of bronchoconstriction) because it can relax the bronchial muscles through central catecholamine release (Fig. 14-5). Succinylcholine can be used for intubation. Of the nondepolarizing muscle relaxants, vecuronium and cisatracurium are good alternatives.

Most of the inhalational agents provide bronchodilatation. Ventricular tachycardia and arrhythmias can occur if halothane is used in the presence of aminophylline or β-mimetic drugs. But halothane is seldom used presently. Recently sevoflurane has been suggested as an alternative to halothane and isoflurane, as it has minimal respiratory stimulating effect unlike desflurane. Inhalation anesthetics can cause uterine muscle relaxation and predispose to obstetric hemorrhage. Intraoperative bronchoconstriction can be effectively treated with β-mimetic drugs administered from a metered-dose inhaler. Extubation also needs careful attention.

**Cystic Fibrosis**

Pregnant women with cystic fibrosis should be followed closely with respect to their lung function. These parturients are often associated with severe pulmonary obstruction and respiratory impairment. For labor and delivery, epidural analgesia is usually the best choice. For cesarean section, the anesthetic technique will depend on the condition of the pregnant woman. Epidural anesthesia should be used whenever possible. This technique is associated with fewer pulmonary complications and can also be utilized for excellent postoperative pain relief. Parturients with severe respiratory impairment may need general anesthesia.
Neurological Problems

Neurological problems are uncommon during the childbearing age. Regional anesthesia is contraindicated in the presence of active inflammatory disease in the spinal canal, acute
meningitis, or superficial infection at the site of the lumbar puncture. However, regional anesthesia may not be contraindicated in old inflammatory problems, e.g., a parturient with a history of poliomyelitis.

**Paraplegia**

The unique phenomenon experienced by paraplegics and quadriplegics is called autonomic hyperflexia or mass reflex. Interestingly, the syndrome is not found if the lesion is below T7. It occurs in 85% of cases with lesions above T7 (Fig. 14-6).

Stimulation of the skin below the level of the lesion, the presence of distension, or contraction of a hollow viscus like urinary bladder, uterus, or gut might precipitate the mass reflex.

![Figure 14–6. Mechanism of autonomic hyperreflexia in paraplegic and quadriplegic patients. (From Abouleish et al. Used with permission.)](image)
This might present in the form of pilomotor erection, sweating, facial flushing, severe headache, bradycardia, and severe hypertension leading to convulsions, loss of consciousness, and possible subarachnoid or cerebral hemorrhage. Eleven percent of paraplegic patients may develop severe hypertension during pregnancy due to mass reflex. The incidence of premature labor is high among paraplegics.

**Anesthetic Management**

**Labor and Delivery.** Epidural analgesia should be used as soon as the patient goes into labor to prevent autonomic hyperreflexia and mass reflex. At Brigham and Women’s Hospital, continuous epidural infusion with 0.125% bupivacaine and 2 μg fentanyl per milliliter (10 mL/h) has been used with excellent outcome. Patient-controlled epidural anesthesia (PCEA) is also a good option. Epidural meperidine has been used in one case with success. The main advantage of epidural opioids is sparing of the resting sympathetic tone, which may already be impaired following cord transection.

**Cesarean Section.** Epidural anesthesia is preferable to spinal anesthesia because the chances of hypotension are less. If general anesthesia is essential, one should avoid succinylcholine administration because of the possibility of hyperkalemia.

**Cerebrovascular Accidents**

Arterial or venous thrombosis is not common. Cerebral hemorrhage can be seen in association with severe preeclampsia. Subarachnoid hemorrhage can occur during pregnancy due to a leaking aneurysm or arteriovenous malformation. Cardiovascular stresses during pregnancy, labor, delivery, and the immediate postpartum period can precipitate a subarachnoid hemorrhage.

**Anesthetic Management**

For labor and delivery a continuous epidural block is advisable. The use of forceps is indicated to shorten the second
stage. In the immediate postpartum period, one should be prepared to treat hypertension aggressively if it occurs. For cesarean delivery, an epidural block is the anesthesia of choice; however, if there is fetal distress or if general anesthesia is indicated for some other reason, one has to be careful about the hypertensive response following endotracheal intubation.

**Multiple Sclerosis**

This disease is characterized by demyelination of the brain and spinal cord. The course is associated with remissions and exacerbations, and is unpredictable in nature. *However, the relapse rate during the first 3 months postpartum is known to be about three times higher than that in nonpregnant individuals.*

**Anesthetic Management**

Bader and colleagues observed the relationship of anesthetic techniques and the type and amount of anesthetic agent used with the postpartum relapse rate of multiple sclerosis at Brigham and Women’s Hospital between 1982 and 1987. Postpartum relapses occurred in 9 of the 32 pregnancies during the first 3 months. Seven women had vaginal delivery, whereas two parturients underwent cesarean section (Tables 14-4, 14-5 and 14-6). Pregnant women who had epidural anesthesia for vaginal delivery did not have a significantly

**Table 14–4. Relapse Rate of Multiple Sclerosis in the First 3 Months Postpartum**

<table>
<thead>
<tr>
<th>Type of Anesthetic</th>
<th>Cesarean Delivery (No. of Cases)</th>
<th>Relapse No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidural</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>General</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Vaginal Delivery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epidural</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Local</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>General</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

From Bader et al. Used with permission from Elsevier.
higher incidence of postpartum relapse than did parturients who received either pudendal or local infiltration. Interestingly, in the relapsed population, all women received a higher concentration of local anesthetic for a prolonged period (>0.25% bupivacaine). The authors suggested (1) that there is no absolute contraindication to the use of regional analgesia for labor and delivery, (2) that the parturient should be informed beforehand about the possibility of postpartum relapse not related to anesthesia, and (3) that lower concentrations of local anesthetics should be used in these individuals to minimize the concentration of anesthetic that reaches the spinal cord.
Space-Occupying Lesions (Brain Tumors)

Labor and Delivery

Spinal anesthesia may be relatively contraindicated in brain tumors because of a sudden reduction in cerebrospinal fluid (CSF) pressure; if it occurs rapidly, it may produce cerebral herniation and death. On the other hand, painful uterine contractions and bearing-down efforts during labor will increase intracranial pressure; hence epidural analgesia may be indicated, but one should bear in mind the consequences of accidental dural puncture. Some authors suggest the use of a bilateral lumbar sympathetic block for the first stage of labor and a pudendal block for the second stage.

Cesarean Section

Most anesthesiologists prefer to use general anesthesia for this purpose. Nonetheless, epidural anesthesia is an option to be considered. For general anesthesia, induction with large doses of narcotics, hypotensive medication (if necessary), sodium thiopental (Pentothal), succinylcholine, and vecuronium may be used. Isoflurane is the inhalation anesthetic of choice since it does not increase cerebral blood flow. Although hyperventilation can reduce the intracranial pressure, it can affect the uteroplacental circulation, and continuous fetal heart rate monitoring, if possible, may be useful until delivery. Arterial and CVP lines may be indicated based on the circumstances. Depending upon the severity of the increase in intracranial pressure, neurosurgeons may prefer to reduce the intracranial pressure by surgical drainage before cesarean section. Medical therapy to decrease intracranial pressure includes steroids and diuretics like furosemide or mannitol, which obviously will be used before surgical intervention. A close FHR monitoring is necessary while using mannitol because of the possibility of severe maternal and fetal hypovolemia. Reduced uteroplacental circulation is also a possibility. Constant communication is necessary between the neurologist, neurosurgeon, obstetrician, and anesthesiologist.

In benign intracranial hypertension (pseudotumor cerebri), the increased intracranial pressure is not related to intracranial
mass, infection, or obstruction to CSF outflow and may be related to decreased CSF absorption. Regional anesthesia, spinal or epidural, is preferred for both vaginal delivery and cesarean section.

**Epilepsy**

There is no evidence that epileptic groups are more susceptible to convulsion from local anesthetics than the normal population. Spinal or epidural anesthesia is not contraindicated in such cases. For general anesthesia, drugs that have potential convulsive action, e.g., enflurane or ketamine, should be avoided.

**Myasthenia Gravis**

The major problems encountered in parturients with myasthenia gravis are as follows:
1. Chance of a prolonged second stage of labor because of muscle weakness
2. Postdelivery pulmonary complications because of respiratory muscle weakness
3. Complications during anesthesia
4. Possibility of neonatal myasthenia gravis

Myasthenic or cholinergic crisis may be evident by progressive generalized bulbar and respiratory weakness. Occasionally, differential diagnosis may be difficult:

<table>
<thead>
<tr>
<th><strong>Myasthenic crisis</strong></th>
<th><strong>Cholinergic crisis</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Progressive deteriorization of the disease process evidenced by cranial nerve involvement (ocular symptoms) as well as respiratory muscle weakness</td>
<td>Often associated with high doses of antiacetylcholinesterase therapy and accompanied by muscarinic side effects like diarrhea, sweating, abdominal muscle cramps, fasciculations, palpitations, increased secretions, and bradycardia.</td>
</tr>
</tbody>
</table>
When differentiation between the cholinergic and myasthenic crisis is not definitive, parturients occasionally may need ventilation and supplemental feeding. Antiacetylcholinesterase should be stopped and then gradually restarted in case of cholinergic crisis. In myasthenic crisis, women may need plasmapheresis followed by immunosuppressive therapy. Although rare, myasthenic parturients may be associated with pregnancy-induced hypertension (PIH). Use of magnesium sulfate for PIH is contraindicated in this situation. Phenytoin may be used in these cases.²⁹

**Labor and Delivery**

Epidural anesthesia is a good option for these patients for labor and delivery analgesia.

**Cesarean Delivery**

Because of the need of a higher level of sensory anesthesia for cesarean delivery, there is always a danger of impairment of the respiratory and swallowing muscles following regional anesthesia. Unless contraindicated because of respiratory insufficiency, regional anesthesia should be the technique of choice. Epidural anesthesia may have distinct advantage as the level of anesthesia can be brought upwards slowly so that the patient has the opportunity to get used to breathing without the assistance of abdominal muscles. Spinal anesthesia has also been used for cesarean delivery successfully. The advantages of neuraxial anesthesia include avoidance of IV opioids, neuromuscular blocking drugs, and anticholinesterases. For epidural, amide local anesthetics are preferable to esters because the women are usually receiving anticholinesterase drugs for their treatment and these can prolong ester local anesthetic activity.³⁰–³² Occasionally, patients may need respiratory assistance via BIPAP during regional anesthesia.³¹

In cases where general anesthesia is indicated, the principles guiding anesthetic management of patients with myasthenia gravis in pregnancy are similar to those used in nonpregnant patients. Due to acetylcholine receptor down-regulation,
patients are very sensitive to nondepolarizing muscle relaxants and potentially resistant to depolarizing muscle relaxants. However, the effect of depolarizing muscle relaxants has been described as inconsistent in patients with myasthenia gravis.\textsuperscript{33} Depolarizing muscle relaxant activity can be prolonged in the presence of anticholinesterase therapy. Despite this succinylcholine should be used to facilitate intubation. Nondepolarizing muscle relaxants should be used in small doses, and a neuromuscular blockade monitor must be used. The anesthesia can be supplemented with short-acting opioids, muscle relaxants, and inhaled anesthetics. Tranquilizers and narcotics should be used cautiously because of the chance of respiratory depression postoperatively.

**Neonatal Myasthenia Gravis**

A transient form of myasthenia gravis occurs in 12% of babies born to myasthenic mothers. It develops within the first 4 days of life. Symptoms include lethargy, poor sucking reflex, feeble cry, generalized muscle weakness, or absent or weak Moro’s reflex. Diagnosis is confirmed by using edrophonium chloride, 0.05–0.1 mL, subcutaneously.

Anticholinesterase therapy may be necessary up to 4 weeks.

**Renal Disorders**

**Physiological Changes**

The major physiological changes are as follows:

1. *The effective renal plasma flow and glomerular filtration rate (GFR) increase by 50% by 16 weeks’ gestation.*

2. The high renal plasma flow and GFR result in an increase in creatinine clearance.

3. During normal pregnancy, the blood urea nitrogen (BUN) level averages 8–9 mg/dL and creatinine, 0.46 mg/dL. Therefore, during pregnancy, normal nonpregnant BUN (10–20 mg/dL) and creatinine (0.5–1.2 mg/dL) levels may represent renal compromise.

4. One of the most common disorders in pregnancy that involves kidney function is preeclampsia.
5. Acute renal failure in pregnancy can occur in conjunction with hemorrhage, sepsis, or preeclampsia.

Anesthetic Management

Several important factors have to be considered before the anesthetic technique is selected:
1. The parturients should undergo dialysis before surgery if time permits.
2. Arteriovenous fistulas should be carefully protected during surgery.
3. Because of the presence of anemia, hyperventilation should be prevented because this will shift the $O_2$ dissociation curve to the left.
4. Drug interactions:
   - Abnormal protein binding may cause prolongation of the thiopental effect.
   - Non depolarizing muscle relaxants dependent on renal clearance should not be used because they are excreted mainly by the kidney: Pancuronium, and to some extent vecuronium, excretion can be prolonged in the presence of renal failure, and cisatracurium is a good choice in these patients.
   - Succinylcholine can increase serum potassium levels; hence, they should be contraindicated in parturients with hyperkalemia. However, patients with chronic renal failure may be more tolerant of hyperkalemia.

Labor and Delivery

Epidural analgesia should be the technique of choice.

Cesarean Section

Epidural technique is preferred over spinal because of less chance of severe hypotension and less need of volume loading, which might be detrimental in parturients with chronic renal failure. If general anesthesia is deemed necessary, the use of succinylcholine depends on potassium level, and if the patient is undergoing frequent dialysis. Propofol, remifentanil,
and ketamine combination can be used with cisatracurium as neuromuscular blocker of choice. Isoflurane and desflurane are the inhalation anesthetics of choice.

**Hematological Disorders**

Besides the hereditary clotting defects, the defects that are of concern in obstetric population are the acquired problems:

1. Drugs that interfere with platelet function (e.g., aspirin, NSAIDS).
3. Liver failure.
4. Disseminated intravascular coagulation, associated with abruptio placentae, amniotic fluid embolism, intrauterine fetal death, and severe preeclampsia. The pathophysiology of disseminated intravascular coagulation consists of simultaneous uncontrolled activation of procoagulants and fibrinolytic enzymes in the microvasculature. The process depletes platelets and procoagulants. Firbrinolysin (plasmin) levels are elevated and this leads to further digestion of fibrin clots, which releases fibrin degradation products and inhibits polymerization of additional fibrin.

Key points of anesthetic management of hematological disorders are:

1. General anesthesia should be the choice because of the clotting problems unless treatment with the medications is stopped beforehand and clotting parameters revert to the normal range (Fig. 14-7).
2. Blood volume replacement and circulatory support may be necessary.
3. Fresh whole blood or red cells and fresh frozen plasma containing all known clotting factors should be used. A 250-mL unit of fresh frozen plasma contains 200–400 mg of fibrinogen and also factors VIII, V, and XIII. Cryoprecipitate is a concentrated preparation of fibrinogen and contains 200–400 mg of fibrinogen in 15–20 mL. Fibrinogen concentrates have recently become available in the US.
4. The administration of procoagulants to replace factors that have been consumed is essential.
Figure 14–7. Regional anesthesia in the heparinized parturient. (From Sharma and Leveno.63)
Sickle Cell Disease

Parturients with sickle cell trait usually have no problems during pregnancy; however, women with S/S or S/C disease may have a higher incidence of obstetric risks. Their anemia becomes more severe during pregnancy, and the incidence of preeclampsia is increased.

Anesthetic Management

Hypoxia and hypotension must be prevented because of the increased chance of sickling. Due attention should be paid to acid–base status, hydration, and temperature monitoring during management of these patients.

Labor and Delivery. Epidural analgesia is the technique of choice, and proper volume expansion with warm fluid is important. Oxygen should be administered and aortocaval compression should be avoided. Hypotension should be immediately corrected.

Cesarean Delivery. Epidural anesthesia, if properly performed, will be associated with good maternal and neonatal outcome. It can also be used for postoperative analgesia, which might be necessary in these women because they might be receiving analgesic drugs because of sickle cell crisis. Warm fluid for volume expansion should be used, and treatment of hypotension should be immediate. If general anesthesia is indicated, adequate oxygenation, maintenance of normal acid–base status, and a warm environment are essential.

Idiopathic Thrombocytopenia

Regional anesthesia may be indicated both for labor and delivery and for cesarean section, provided that the clotting parameters are normal. If coagulation parameters are abnormal and clinical features of prolonged bleeding are present, general anesthesia will be necessary for cesarean section. Gentle intubation with a small-sized endotracheal tube is important for preventing hematoma of the vocal cords.
Von Willebrand Disease

Table 14-7 describes the classification of Von Willebrand disease.

Treatment consists of DDAVP, 0.3 mg/kg, especially in type 1. DDAVP should not be given in type 2b as it may worsen bleeding. During therapy, close monitoring of vWF levels is necessary; the parturient may develop tachyphylaxis when treatment is used for more than 48 h. The administration of neuraxial block depends on the type of the disease and coagulation profile. Neuraxial block has been successfully administered in patients with type 1. The customary practice at Brigham and Women's Hospital is to administer neuraxial block after checking coagulation profile and administering DDAVP, where indicated.

Hypercoaguable States

Protein C and Protein S Deficiency, Phospholipid and Cardiolipin Antibodies

Protein C is a vitamin K-dependent hepatic protein and is converted to an active protease by thrombin. Activated protein C in conjunction with protein S proteolyses factors Va and VIIIa, which interferes with the fibrin formation. Deficiencies of protein C and S cause recurrent venous thrombosis and pulmonary embolism. Presence of phospholipid and cardiolipin antibodies also result in hypercoagulable state. Heparin therapy may be necessary during pregnancy.

Factor V Leiden Mutation

Carriers of the factor V Leiden mutation have a high risk of fetal loss because of placental blood vessel thrombosis. Anticoagulant therapy is indicated from the beginning of pregnancy.

Presently, these patients are generally on low molecular weight heparins (LMWH). The usual procedure is to switch LMWH to regular heparin before 38 weeks’ gestation to enable administering regional anesthesia following usual guidelines.
Table 14–7. Classification of Von Willebrand Disease (Incidence/1:10,000)\textsuperscript{34}

<table>
<thead>
<tr>
<th>Type</th>
<th>vWF:Ag</th>
<th>vWF:RCo</th>
<th>Factor VIII</th>
<th>vWF Multimer structure</th>
<th>DDAVP response</th>
<th>Bleeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>Normal</td>
<td>Good</td>
<td>Mild–moderate</td>
</tr>
<tr>
<td>2 A</td>
<td>↓</td>
<td>↓↓</td>
<td>↓</td>
<td>Abnormal</td>
<td>Variable</td>
<td>Variable</td>
</tr>
<tr>
<td>2 B</td>
<td>↓ to normal</td>
<td>↓</td>
<td>↓ to normal</td>
<td>Abnormal</td>
<td>May worsen thrombocytopenia</td>
<td>Thrombocytopenia may worsen bleeding</td>
</tr>
<tr>
<td>2 M</td>
<td>↓ to normal</td>
<td>↓</td>
<td>↓ to normal</td>
<td>Abnormal</td>
<td>Variable</td>
<td>Variable</td>
</tr>
<tr>
<td>2 N</td>
<td>↓ to normal</td>
<td>↓</td>
<td>↓ to normal</td>
<td>Normal</td>
<td>Variable</td>
<td>Variable</td>
</tr>
<tr>
<td>3</td>
<td>↓↓↓ or absent</td>
<td>↓↓</td>
<td>↓↓↓</td>
<td>Normal</td>
<td>No response</td>
<td>Severe</td>
</tr>
<tr>
<td>3</td>
<td>↓↓↓ or absent</td>
<td>↓↓</td>
<td>↓↓↓</td>
<td>Normal</td>
<td>No response</td>
<td>Severe</td>
</tr>
</tbody>
</table>
of timing of heparin withdrawal and checking PTT. An alternative is to discontinue prophylactic doses of LMWH at least 10–12 h before regional anesthetic. Therapeutic doses of LMWH should be discontinued at least 24 h prior to regional anesthesia. Utilization of dilute solutions of local anesthetic with opioid mixture allows for monitoring of the parturient’s neurologic status after neuraxial block. It is also recommended to wait at least 2 h after the removal of an epidural catheter before giving a dose of LMWH.

The heparin test, an anti-Xa chromogenic assay that is often used to follow the activity of LMWH, takes 15 min to perform at our institution. Although the American Society of Regional Anesthesia and Pain Medicine (ASRA) guidelines do not recommend following the anti-Xa level, it is the practice of the authors to perform this test in parturients that are taking therapeutic doses (>1 mg/kg enoxaparin) of anticoagulants even if the last dose was given more than 24 h before the test. We also use this test whenever a prolonged effect of LMWH is anticipated. The target is a heparin test of less than 0.2 U/ml. A recent study demonstrated a correlation between the thromboelastogram (TEG) R-time and the heparin test. In the future TEG may play a significant role in determining the patient’s suitability for regional anesthesia.

Autoimmune Disease

Rheumatoid Arthritis

Women with severe rheumatoid arthritis may encounter multiple problems on the anesthesiology team:
1. Difficult intubation because of severe flexion deformity of the neck along with atlantoaxial instability.
2. Deformity of hip, knee, and intervertebral joints, thus making insertion of an epidural needle difficult and sometimes impossible
3. Restrictive lung disease and occasionally pleural effusion
4. Associated cardiac problems
5. Involvement of peripheral nerves with associated sensory and motor deficits
6. Effect of different medications like high-dose aspirin or nonsteroidal anti-inflammatory drugs

**Anesthetic Management**

If possible, epidural or continuous spinal analgesia is preferable provided that the clotting parameters are within normal limits. The main advantage of this technique is the avoidance of difficult intubation if emergency cesarean section is indicated. On the other hand, some anesthesiologists prefer to secure the airway by fiberoptic technique, if necessary, before proceeding with cesarean delivery.

**Systemic Lupus Erythematosus**

The major problems of this multiorgan disease include the following:

1. Cardiomyopathy, chronic hypertension, coronary artery disease, and nonspecific T-wave changes on the ECG. 42, 43
2. Higher incidence of preeclampsia. 43
3. Pulmonary vasculitis, pulmonary infarcts.
4. Renal problems, evident by the presence of high BUN and creatinine concentrations.
5. CNS as well as peripheral nervous system involvement.
6. Hematologic abnormalities. The presence of lupus anticoagulant may prolong the PTT and rarely the PT secondary to its reaction with the phospholipids used in the test. 44
   On the other hand, anticardiolipin antibodies detected in parturients with systemic lupus erythematosus may be associated with thrombocytopenia in addition to abnormal PTT or PT. However, patients are generally hypercoagulable.
7. The increased incidence of thrombosis in parturients with systemic lupus erythematosus may require anticoagulant therapy.
8. Rarely, lupoid hepatitis.

**Anesthetic Management**

Anesthetic management either for labor and delivery or for cesarean section will depend on the severity of the disease and
organs involved. If clotting parameters are normal, one can use regional anesthesia, but invasive monitoring may be necessary in women with severe respiratory and cardiovascular problems. General anesthesia may be necessary in the presence of clotting abnormalities. Recently, Harnett et al. have used TEG to determine the coagulation status in patients with phospholipid antibodies receiving prophylactic heparin. If the TEG’s R parameter is within normal range, it suggests no significant levels of heparin in patients with laboratory evidence of prolonged PTT.\textsuperscript{45}

Maternal Addiction

The following are among the major problems when faced with maternal opioid addiction:

1. Withdrawal symptoms occur if parturients do not receive the opioids.
2. There is an increased likelihood of perinatal mortality from maternal opioids addiction because of prematurity and low birth weight.
3. Maternal withdrawal may trigger fetal withdrawal and lead to fetal hyperactivity, an increase in oxygen consumption, and fetal hypoxia.
4. An acute drug overdosage may cause hypotension and fetal death.
5. The chance of maternal hypotension during anesthesia is greater because of adrenal insufficiency, associated hypovolemia, or the possibility of maternal overdose from opioids.
6. Starting an intravenous infusion can be difficult.

Cesarean delivery in the presence of cardiovascular, respiratory, or neurological problems secondary to addiction may occasionally make regional anesthesia unsafe. General anesthesia can be given in such situations. The majority of these patients may have associated liver problems that can prolong the duration of anesthetic medications. Inhalational agents such as sevoflurane or desflurane may be ideal due to their rapid recovery.

Active resuscitation of the neonate may also be necessary. Postoperative pain relief is always a problem in these
patients because of tolerance. The use of epidural anesthesia for postoperative pain relief might be beneficial in such cases.

**Alcohol**

**Major Problems**

Medical complications including hemorrhage because of esophageal varices and clotting abnormalities due to abnormal liver function, cardiomyopathy, neuropathy, and the possibility of increased gastric volume and gastric acidity are some of the problems to be considered before the administration of anesthesia. There is also the possibility of fetal alcohol syndrome.

**Anesthetic Management**

Both for labor and delivery and for cesarean delivery, epidural anesthesia is safe as long as there are no clotting abnormalities. Spinal anesthesia is also a good option if there is no significant cardiac involvement. Regional anesthesia will help to minimize the chances of aspiration.

**Amphetamines**

**Anesthetic Management**

Since amphetamines are CNS stimulants, they cause depletion of CNS catecholamines and might cause a poor response to indirectly acting sympathomimetic agents like ephedrine. An increased anesthetic requirement is a possibility if one uses general anesthesia. Epidural anesthesia might be a better choice in this situation, and hypotension may be treated with small doses of phenylephrine, if ephedrine is ineffective.

**Cocaine**

Cocaine blocks the presynaptic uptake of norepinephrine, serotonin, and dopamine. In the CNS, it increases monoamine
neurotransmitter levels and lowers the seizure threshold.\textsuperscript{46} “Crack” is commonly smoked at the present time, and free base cocaine is rapidly absorbed across the pulmonary blood vessels and reaches the CNS in high concentration. Severe hypertension and tachycardia can be a problem for the anesthesiologist. Because of its vasoconstriction property, cocaine will reduce uteroplacental blood flow, and abruptio placentae and labor can occur immediately following self-administration of cocaine.\textsuperscript{47} Multiple congenital abnormalities, growth retardation, and decreased weight have been described in neonates of cocaine-addicted mothers. Placental abruption is associated with coagulation abnormalities and this should be checked before regional anesthesia.

**Anesthetic Management**

**Labor and Delivery.** Epidural analgesia is the most effective method of pain relief in cocaine-addicted parturients. Chronic cocaine use can cause thrombocytopenia and therefore platelets should be checked before placement of regional anesthesia.

**Cesarean Section.** Regional anesthesia should be the anesthetic of choice. Epidural anesthesia is associated with a decreased incidence of hypotension, and it can be used for effective control of postoperative pain. Hypotension has been treated with ephedrine successfully. Phenylephrine (50–100 $\mu$g) may be necessary in certain circumstances. Cocaine may decrease the plasma cholinesterase concentration and may prolong the action of 2-chloroprocaine.

General anesthesia may be necessary in the presence of acute fetal distress associated with abruptio placentae. Reflex hypertension and tachycardia during intubation can be treated with labetalol. A decreased pseudocholinesterase activity can prolong the duration of action of succinylcholine. Severe tachyarrhythmias may be associated with general anesthesia.
Infectious Diseases

Genital Herpes

Caused by herpes simplex virus (HSV) types 1 and 2, the majority of genital herpes lesions are caused by the HSV-2 virus. Most obstetric management issues revolve around possible transmission of the virus to the neonate at the time of birth. Current recommendations for obstetric management include the following (ACOG Practice Bulletin. Obstet Gynecol 2007;1029:1489):

1. The route of delivery should be determined by assessment of the lesion at the time of delivery.
2. Viral cultures are no longer recommended.
3. If no evidence of a lesion exists, vaginal delivery is recommended. The viral culture result is delivered to the pediatrician.
4. Any suggestion of a positive lesion is generally an indication for cesarean section.

Anesthetic management of a primary lesion is controversial. In the author’s institution, regional anesthesia is not used if there is any indication of a primary lesion because primary HSV infections are associated with viremia and the possibility of encephalitis. In the case of secondary infection, we prefer regional anesthesia both for labor and delivery and for cesarean section even during the active phase unless contraindicated for other reasons. Bader et al. reported a 6-year retrospective survey of 169 parturients who underwent cesarean section with a diagnosis of HSV. A total of 164 parturients had secondary infection, whereas 5 had a diagnosis of primary infection. Fifty-nine women had general anesthesia, 75 received spinal anesthesia, and 35 received epidural anesthesia. None of the parturients with secondary infection who received regional anesthesia had any evidence of septic or neurological complications (Fig. 14-8, Table 14-8). Convincing data exist regarding the use of intraspinal morphine and increased risk of recurrent HSV-1 (generally oral). Anesthesiologists should be cautious about using the intraspinal morphine for postoperative analgesia in parturients with a history of an HSV-1 infection.
Infection with the Human Immunodeficiency Virus

Acquired immunodeficiency syndrome (AIDS) is the end-stage condition of a disease caused by the human immunodeficiency virus (HIV). Women of reproductive age are the fastest growing population with HIV. Seroprevalence of HIV during pregnancy has been estimated to be 1.7 per 1,000 pregnancies. Common signs and symptoms have become more moderate or subclinical, and new clinical presentations have emerged. It is quite apparent that HIV disease affects multiple organ systems. Advances have been made in elucidating the pathogenesis of HIV. In addition, the molecular technique of viral load determination and the CD4+ T-lymphocyte count enable evaluation of the disease, its prognosis, and its response to therapy.

There is limited specific information concerning the overall risk of anesthesia and surgery of HIV/AIDS patients. However, as far as can be determined, surgical interventions do not
### Table 14-8. Indications for Cesarean Delivery (No. of Cases by Year)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Active lesion present at delivery</td>
<td>24</td>
<td>27</td>
<td>27</td>
<td>26</td>
<td>15</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>Healing lesion present at delivery</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>No active lesion but positive cultures within 2 wk of delivery</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Total cases</td>
<td>30</td>
<td>29</td>
<td>28</td>
<td>30</td>
<td>17</td>
<td>22</td>
<td>13</td>
</tr>
</tbody>
</table>

Reprinted from Bader et al.,48 with permission from American Society of Regional Anesthesia and Pain Medicine.
increase the postoperative risk for complications or death and therefore should not be withheld. There is also little evidence to suggest that HIV or antiretroviral drugs increase the rate of pregnancy complications or that pregnancy may alter the course of HIV infection. It should be emphasized that all practicing anesthesiologists should be familiar with the disease and should use prenatal anesthesia consultations and a team approach to assure optimal treatment for HIV patients.49

Anesthetic Technique

The CNS manifestations can include paralysis, ataxia, encephalitis, and coma. The virus has been isolated from the CSF from parturients with HIV.50 Anesthesiologists should carefully look for any evidence of neurological deficit before the administration of anesthesia, and pregnant women should be told about the possibility of continuation of the neurological problems that might not be related to the anesthetic technique in any way. Regional anesthesia should not be contraindicated in a parturient with AIDS. Yet, one must take into consideration the presence of neuropathies, local infection, or blood-clotting abnormalities. General anesthesia is considered safe, but drug interactions and their impact on various organ systems should be considered preoperatively. There is a possibility of difficult endotracheal intubation due to pharyngeal lymphatic hypertrophy.51

Risk to the Anesthesiologist

Of all cases, 0.5% are estimated to be infected with HIV.52 Hence, care should be taken when contact with bodily fluids is anticipated. Double gloves, mask, gown, eye wear, etc. should be used. Caution is also needed while handling needles and sharp objects.

Psychiatric Disorders

Psychiatric disorders of women of childbearing age are as follows:
I. Schizophrenia
   A. Paranoid
   B. Schizoaffective
   C. Medications commonly used:
      1. Phenothiazenes
      2. Butyrophenones

II. Bipolar disorder
   A. Manic with or without psychotic features
   B. Mixed with or without psychotic features
   C. Depressed with or without psychotic features
   D. Medications commonly used:
      1. Lithium
      2. Carbamazepine
      3. Valproic acid (Depakote)

III. Major depression with or without suicidal tendency
   A. Medications commonly used:
      1. Tricyclic antidepressants, seratonergic as well as nonadrenergic types
      2. Monoamine oxidase inhibitors

IV. Dysthymia
   A. Medications commonly used: tricyclic antidepressants

V. Miscellaneous diagnostic categories
   A. Panic disorder with or without agoraphobia
   B. Generalized anxiety disorder
   C. Anorexia and/or bulimia
   D. Post-traumatic stress disorder
   E. Obsessive-compulsive disorder
   F. Medications commonly used:
      1. Tricyclic antidepressants
      2. Benzodiazepines
      3. Phenothiazenes
      4. Monoamine oxidase inhibitors

Clinical Implications

Because of recent evidence of the relationship between neurohormonal imbalance and psychiatric disorders, various medications have been used for the treatment of different psychological problems. Drug interactions between psychotropic
medications and anesthetic techniques and agents have been discussed in Chapter 4.

**Malignant Hyperthermia**

Only a few cases of malignant hyperthermia during pregnancy have been reported. The clinical features of malignant hyperthermia under anesthesia include (1) hypercarbia, (2) tachycardia, (3) hypertension, (4) muscle rigidity, (5) tachypnea, (6) lactic acidosis, and (7) rapidly increasing body temperature. Recommended laboratory analyses during malignant hyperthermia are shown in Table 14-9. The hotline telephone number for the management of malignant hyperthermia is 800-644-9737. The website is www.mhaus.org.

**Anesthetic Management**

*Regional Anesthesia*

It would appear that regional anesthesia is preferable for labor and delivery as well as cesarean delivery. Currently, most anesthesiologists agree with the use of either amide

**Table 14–9. Recommended Laboratory Analyses for Malignant Hyperthermia**

<table>
<thead>
<tr>
<th>Central Venous Blood Gas Analysis</th>
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<tr>
<td>Arterial blood gas analysis</td>
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<tr>
<td>Central venous electrolytes (Na⁺, K⁺, Cl⁻, HCO₃⁻)</td>
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<tr>
<td>Serum glucose</td>
</tr>
</tbody>
</table>

**Central Venous Creatine Phosphokinase**

and isoenzymes – immediately and every 12 h

**Hemoglobin or Hematocrit Fibrinogen**

and fibrin degradation products

**Plasma myoglobin**

**Urine Myoglobin**

**Urine pH**

From Longmire et al. Used with permission from Elsevier. Essential studies shown in boldface type.
or ester local anesthetics. The addition of epinephrine to the local anesthetic is felt to be contraindicated because \( \alpha \)-adrenergic agonists precipitate malignant hyperthermia in pigs, but this is controversial. The authors have used ephedrine for the treatment of hypotension without problems, but one might consider using phenylephrine in such cases. We have also used epinephrine-containing local anesthetics for epidural anesthesia.

**General Anesthesia**

If general anesthesia has to be used, then one must avoid depolarizing muscle relaxants and inhalational anesthetics or other triggering agents. Dantrolene should be always readily available.

**Role of Dantrolene.** Dantrolene crosses the placenta, and a fetal blood level of about 60% of that of the mother is reached. There are no reports of adverse neonatal effects but it may cause transient hypotonia. Prophylaxis with dantrolene is a matter of debate. While it seems safe to administer, its use may not be necessary. If used, the prophylactic dose is 2.4 mg/kg intravenously given over a period of about 15 min preoperatively. Most authorities do not recommend prophylactic dantrolene and will avoid the agents that trigger malignant hyperthermia. Another potential problem that has been described recently in the literature is the occurrence of uterine atony following dantrolene treatment.

**Obesity**

The major problems associated with maternal obesity are as follows:

1. Associated medical problems like hypertension, respiratory insufficiency, diabetes mellitus, etc., are common.
2. The volume of gastric contents may be high and with a low pH. However, a recent study contradicted these findings. Harter et al. found a lower incidence of combined high-volume, low-pH gastric contents in obese patients as compared to lean patients.
3. There can be technical difficulty with regional anesthesia.
4. Obstetric complications are high in this group of parturients.
5. Laryngoscopy may be difficult in such cases.
6. There is high incidence of failed epidural catheters and multiple attempts for epidural placement.

Anesthetic and obstetric outcome of 117 morbidly obese parturients were studied retrospectively. The findings included (1) higher oxytocin use, (2) higher rate of cesarean section (62% compared with 24% in the control group), (3) significantly more initial epidural anesthesia failure (42% compared with 6% in normal parturients), (4) significantly higher incidence of accidental dural puncture, and (5) increased incidence of difficult intubation.\textsuperscript{55} Recently, a maternal mortality study (1985–2005) from Michigan showed that six out of eight pregnant women who died were obese.\textsuperscript{56,57}

**Anesthetic Management**

*Labor and Delivery*

Epidural analgesia is preferable and should be used if technically possible. Continuous spinal analgesia has also been used with success. We prefer sitting position for epidural placement.

*Elective Cesarean Section*

If one considers regional anesthesia, single-shot spinal anesthesia should be used cautiously, if at all, because of the following:
1. Control of the spinal anesthetic level is unpredictable.
2. There is a very high incidence of hypotension.
3. Spinal anesthetic can reach higher levels and cause further compromise of the already abnormal pulmonary function. However, continuous spinal anesthesia may reduce these problems. For epidural anesthesia, the volume of the local anesthetic might have to be reduced. CSE technique using a small amount of local anesthetic for spinal portion may be a good option (sequential CSE). This allows flexibility of anesthetic duration.
General Anesthesia

If general anesthesia is necessary, one should carefully check the airway before the induction of anesthesia. Laryngoscopy may prove difficult in these cases because both the chest and large breasts often impede the use of the usual laryngoscope handle. Use of a short-handle laryngoscope (Datta-Briwa) can circumvent this problem (Fig. 14-9). Awake intubation using a laryngeal mask airway has been described. Special laryngoscopes like Bullard’s laryngoscopes such as Bullard have been used in morbidly obese pregnant women.58

Figure 14–9. Datta-Briwa short-handle laryngoscope.

Summary

With increasing number of parturients with comorbid diseases reaching childbearing age, a thorough understanding of pathophysiology of the disease process is essential to determine the ultimate effect of physiological changes of pregnancy on the parturient. Occasionally, the physiological changes of pregnancy can tilt the delicate balance of well-being towards the side of clinical decompensation. When this occurs, a multimodal team approach is the key to safely maneuver the parturient through the pregnancy, delivery, and postpartum period.

References


