

Analgesia and Anesthesia for the Obstetric Patient

Practice Guidelines

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Introduction

The American Association of Nurse Anesthetists (AANA) supports patient safety through the use of evidence-based analgesia and anesthesia practices. These practice guidelines offer guidance for anesthesia professionals to manage the analgesia and anesthesia care of obstetric patients during labor and delivery. In the context of these guidelines, anesthesia is the care provided for surgical intervention (e.g., cesarean section), and analgesia is the care provided for pain management (e.g., labor epidural, post-cesarean pain control). These guidelines do not supersede federal, state or local statutes or regulations, accreditation standards, or facility policy, but constitute practice recommendations and considerations to be referenced to develop each patient’s unique plan of care. Healthcare professionals must maintain their familiarity with evolving obstetric analgesia and anesthesia practices as they are updated in federal, state and local statutes and regulations, as well as nationally recognized obstetric care practices and guidelines and scientific literature.

The responsibility of the anesthesia professional is to provide care for the parturient receiving analgesia or anesthesia. It is important that Certified Registered Nurse Anesthetists (CRNAs) work with the interprofessional team to provide coordinated care for the obstetric patient, with consideration of the fetus and neonate. Early communication between the anesthesia, obstetric, and pediatric professionals regarding labor status and patient-specific considerations creates an optimal environment for safe maternal and neonatal care.

CRNAs have an ethical duty to protect the patient, prevent unnecessary harm and abide by the AANA *Standards for Nurse Anesthesia Practice* and *Code of Ethics for the Certified Registered Nurse Anesthetist*.^{1,2} In life-threatening emergencies requiring immediate action, weigh the relative risk to patient life and determine the most appropriate plan of care. Through a team-

based quality improvement program, review unusual or adverse events, and identify opportunity for process improvement, education and training to improve patient outcomes and safety.

The AANA and our content experts have no financial interest related to the content of these guidelines. These guidelines include discussion of the off-label use of a few medications, which will be identified by an asterisk*.

Pre-anesthesia Assessment and Evaluation

Anatomical and physiologic changes occur during pregnancy to protect and nourish the developing fetus and prepare the woman for delivery.^{3,4} Changes in maternal physiology include, but are not limited to:⁵⁻¹³

- **Anatomic**
 - Increased body weight.
 - Increased chest circumference, breast volume.
 - Exaggerated lordosis.
- **Respiratory**
 - Airway: oropharyngeal and glottic edema.
 - Increased minute ventilation and oxygen consumption.
 - Decreased functional residual capacity.
- **Cardiac**
 - Increased circulating volume resulting in an increase in cardiac output, stroke volume, and heart rate.
- **Vascular**
 - Decreased systemic vascular resistance.
 - Peripheral venous engorgement and stasis.
- **Gastrointestinal**
 - Delayed gastric emptying.
 - Increased gastric acidity.
 - Reduced pressure at the lower esophageal sphincter.
- **Hepatic**
 - Decreased pseudocholinesterase, serum albumin and gallbladder emptying.
- **Endocrine**
 - Insulin resistance and relative hypoglycemia.
- **Immunologic**
 - Increased leukocytes, resulting in elevated core temperature during pregnancy and labor.

- **Hematologic**
 - Dilution of plasma proteins, increase in plasma volume, decrease in red blood cell volume.
 - Increased platelet consumption and increased platelet aggregation.
 - Almost all factors increase, creating a hypercoagulable state.

- **Renal**
 - Increased renal blood flow, thus increased glomerular filtration rate and creatinine clearance.
 - Decreased blood urea nitrogen (BUN) and creatinine.

The AANA document *Documenting Anesthesia Care*³ recommends assessment and evaluation criteria regarding general health, allergies, medication history, preexisting conditions, and anesthesia history in order to develop a patient-specific plan for analgesia and anesthesia. Lab work should be ordered on an individual patient basis. Areas specific for the evaluation and assessment of the obstetric patient include:

- Current medications that interact with labor analgesics and anesthetics (e.g., selective serotonin reuptake inhibitors, anticoagulants, anti-hypertensives, naltrexone/buprenorphine, herbal medications/supplements).
- Current or recent alcohol, stimulant or opioid use (recreational or prescribed).
- Identification of difficult airway and/or generalized tissue edema.
- Last oral intake prior to admission.
- Cause of fever greater than 38 degrees Celsius.
- Need for additional diagnostic tests (e.g., preeclampsia, renal impairment, significant cardiovascular disease, autoimmune disease).
- Fetal status.

Patients whose obstetric anesthesia care may be challenging or are known to be at risk of significant morbidity should be evaluated for analgesia and anesthesia prior to labor in collaboration with the interprofessional team.^{14,15} Examples of patient conditions that may pose an increased risk for analgesia and anesthesia include, but are not limited to:

- Morbid obesity.
- Hypertension, chronic and new onset.
- Thrombocytopenia, anti-clotting therapy (i.e., antiplatelet, anticoagulant).
- Spinal fusion, spine surgery or musculoskeletal defect (e.g., scoliosis).
- Chronic pain.
- Substance use disorder.
- Infectious disease or infection (e.g., HIV, influenza, chorioamnionitis).
- Anesthesia risk (e.g., history of difficult intubation or adverse reaction to anesthesia, obstructive sleep apnea, malignant hyperthermia).
- Cardiac (e.g., cardiomyopathy, congenital/acquired disorders, presence of implanted pacemaker).

- Neurologic (e.g., seizure disorder, para/quadruplegia, increased intracranial pressure, intracranial lesion).

Patient Education, Plan for Anesthesia Care and Informed Consent

The anesthesia professional, in partnership with the interprofessional healthcare team, develops the plan of anesthesia care with the patient as an engaged, informed and active decision-maker. The informed consent process provides an opportunity for the anesthesia professional and the patient to share information and explore patient needs, preferences, previous experiences, and concerns to develop the plan for anesthesia care.¹⁶⁻¹⁹ The AANA document, *Informed Consent for Anesthesia Care*²⁰ provides additional details regarding the elements of informed consent, including special considerations for obstetric patients.

It is ideal to discuss options for analgesia and anesthesia as early as possible.^{21,22} When obtaining informed consent during active labor, time the discussion to occur between contractions to allow the patient to best participate in the discussion. With the patient's consent, conduct discussions when the patient's family or other support persons are present in compliance with the patient's wishes and applicable healthcare privacy laws.

Consider patient and family demographics, sociocultural factors and health beliefs during the informed consent process. When communicating with the patient, considerations include, without limitation, socioeconomic status, family structure, disease history, religion, immigration status and decision-making styles (e.g., familial, individual, delegated, deferential). Modify the tone and pace of the discussion to meet the patient's level of understanding, and verify that the patient understands the information that has been shared. Family members should not act as medical translators. Access available facility resources, such as translation and language assistance services, to provide information in the patient's spoken or visual language in compliance with applicable law

As appropriate for the patient and the situation, provide the following information during the informed consent discussion:

- Goals for intrapartum care, post-anesthesia care and recovery.^{17,23}
- Pharmacologic and non-pharmacologic labor and delivery analgesia and anesthesia considerations for each phase of labor and delivery (e.g., natural, hydrotherapy, spinal, epidural, combined spinal-epidural, general anesthesia), including special emergent or emergency circumstances (e.g., early to active labor, failure to progress, trial of labor after cesarean section (TOLAC) emergent or emergency cesarean).²⁴
- Risks associated with analgesia and anesthesia (e.g., dural puncture with subsequent headache, backache, incomplete or high block, nerve damage, unintended awareness during general anesthesia).²⁵
- Possibility of delay in labor analgesia due to other patient need for the anesthesia professional to provide care. In such situations, alternative analgesia can be provided by the obstetric professional if a second anesthesia professional is unavailable.

- Potential situations that necessitate the conversion to general anesthesia (e.g., inadequate block, high-block, fetal emergency) to facilitate delivery and help manage complications.^{25,26}

Consent for Tubal Sterilization

Federal Medicaid regulations require that there are at least 30 days between the date of consent and the tubal sterilization procedure unless a premature delivery occurs, and the consent remains valid for 180 days. If a premature delivery occurs within 30 days of consent, the sterilization must be performed not less than 72 hours after informed consent for the procedure.^{27,28} State law, including insurance regulations, may have additional parameters regarding the time frame between consent and the tubal sterilization procedure.

Emergent and Emergency Surgery

During the informed consent process, the anesthesia professional discusses analgesia and anesthesia care for labor and delivery and risks of possible emergent procedures. In an emergent situation, if patient status permits, discuss what the patient will experience and answer any questions she and/or her support person may have.^{29,30}

When a maternal or fetal emergency occurs on transfer from the emergency department, patient history is quickly acquired during handoff, and when possible, from the patient as emergent care is simultaneously provided. If immediate treatment or intervention is warranted because the patient is unconscious or incapable of consenting and the harm from failing to perform the procedure is imminent and outweighs the potential harm from performing the procedure, consent is often implied, and the nature of the need for immediate intervention is documented.³¹ When the patient is unable to provide consent, the anesthesia professional should attempt to secure the consent of the legal decision maker, or, if there is no legal decision maker, a family member.^{23,29,31,32} An advance directive executed by the patient may identify the legal decision maker or specify the patient's wishes. Emergent care should be reflected on the anesthesia professional's documents and in the patient's medical record.³⁰

Pregnancy in Minors

The majority of states and the District of Columbia permit minors to receive confidential prenatal care and routine labor and delivery services.³³ State or local law may include qualifications or conditions, such as a minimum age for the minor to give valid consent or allowing healthcare providers to inform parents that their minor daughter is receiving services if the provider deems it in the minor's best interests.^{32,34} Facility policy should include state-specific law regarding the legal ability of a pregnant minor to consent to obstetric anesthesia. For more information on minors, emancipated minors and mature minors, review the AANA document [Informed Consent for Anesthesia Care](#).²⁰

Maternal-Fetal Conflict

Although rare, there are situations in which a patient may refuse consent for anesthesia (e.g., refusal for an emergency cesarean delivery) that may jeopardize her and her fetus's health or life.^{25,32} In these situations, an anesthesia professional may be caught in an ethical conflict between the principles of beneficence (promoting patient well-being and doing no harm) and

respect for the mother's autonomy.^{25,32} While some court decisions have ruled to protect fetal rights, others have ruled in favor of the mother's autonomy.²⁵ When such conflicts arise, the anesthesia professional should respectfully continue to dialogue with the patient in a non-coercive manner and be available should the patient modify her decision. The healthcare team references applicable hospital policy and guidelines during the development of a collaborative, dynamic plan to address the rights and safety of the fetus and parturient in a maternal-fetal conflict.²⁵ An ethics consultation may provide helpful information to address maternal-fetal conflicts.³⁵ The anesthesia professional should carefully document the informed consent process and the reasons for refusal of anesthesia services.^{22,36}

Anesthesia for Procedures during Pregnancy

Procedures that require anesthesia may occur during pregnancy but should be avoided until after delivery when possible. Anesthesia during pregnancy balances the optimal care and safety of both the mother and the fetus.³⁷ Anesthetic agents have the potential to be teratogenic to the fetus; therefore unnecessary exposure to agents should be avoided when possible.^{13,37} If there are no or minimal increased risks for the mother, consider delaying essential procedures requiring anesthesia until the second trimester to avoid teratogenic effects.^{38,39} If there is a need for emergency surgery, consult with an obstetric professional prior to the surgery.

Considerations for anesthesia during pregnancy include:^{37,38,40}

- Neuraxial is preferred to general anesthesia, when possible.
- Maintain normal maternal physiology.
- Consider limiting use of nitrous oxide in patients receiving inhalational anesthesia during the first trimester.
- Avoid aortocaval compression.
- Optimize uteroplacental perfusion.
- Monitor fetal status.
 - Decision to use fetal monitoring should be individualized, based on parameters such as gestational age, type of surgery, and facilities available.
 - If the fetus is considered viable, it is generally sufficient to ascertain the fetal heart rate before and after neuraxial or general anesthesia.
 - Monitor maternal contractions after procedure for viable fetus.

Analgesia and Anesthesia for Labor and Delivery

Choice of pain relief should be based on patient condition, provider skill set and the resources available at the practice setting. Analgesia and anesthesia considerations are unique for each patient during the three stages of labor, beginning prior to regular uterine contractions, through vaginal or surgical delivery, and continuing after delivery to address any acute pain management needs. Analgesia is individualized to address the stage of labor, maternal discomfort and fetal status.^{14,41} A multimodal plan for labor and, when necessary, surgical analgesia, limits the use of opioids through a patient-specific plan of care that integrates non-pharmacologic, parental opioid, non-opioid, neuraxial and surgical field block. Refer to facility policy for guidance regarding family member presence during analgesia and anesthesia procedures.

Infection Prevention and Control for Obstetric Care

Infection prevention practices are important for patient, family and healthcare professional safety. They include hand hygiene, personal protective equipment, safe injection practices, sterile technique and proper skin preparation. The AANA *Infection Prevention and Control Guidelines for Anesthesia Care*⁴² and AANA *Safe Injection Guidelines for Needle and Syringe Use*⁴³ offer guidance on infection control practices. Additional resources are available at www.aana.com/infectioncontrol.

Staff and Resource Availability

Collaboration with facility leadership and the departments of obstetrics, nursing and anesthesia to develop evidence-based policies and procedures regarding staffing availability for the facility and on call, should consider staffing variations in the design and size of obstetric units; demands of particular surgical, diagnostic or therapeutic procedures; patient and provider safety; and anticipated needs of the obstetric patient and fetus. The timeframe for anesthesia and surgical personnel to be available from the decision to proceed with a cesarean delivery to the beginning of the cesarean delivery depends on such facility policy.⁴⁴

Routine and emergency equipment, drugs, supplies, and other resources should be available in the area where analgesia and anesthesia is performed.⁴⁵ Recommended drugs, equipment and monitors for obstetric analgesia and anesthesia are described below in Table 1.

Table 1. Recommended drugs, equipment and monitors for obstetric analgesia and anesthesia^{46,47}

Drug	Equipment	Monitor
<ul style="list-style-type: none"> • Hypnotic-amnestic agents (e.g., propofol, ketamine, midazolam) • Succinylcholine[‡] • Ephedrine • Epinephrine • Phenylephrine • Atropine • Calcium chloride • Sodium bicarbonate • Naloxone • Uterotonic medications • Lidocaine • IV fluids 	<ul style="list-style-type: none"> • Oxygen • Suction with tubing and catheters • Self-inflating bag and mask for positive-pressure ventilation • Face masks • Oral airways • Laryngoscope • Endotracheal tubes with stylet • Eschmann stylet • Qualitative carbon dioxide detector • Peripheral nerve stimulator • Infusion pump • Flashlight • Ventilator • Patient warming device 	<ul style="list-style-type: none"> • Electrocardiogram • Noninvasive blood pressure • Pulse oximetry • Capnography • Oxygen and volatile agent analyzers

Volume Resuscitation	Difficult Airway Considerations
<ul style="list-style-type: none"> • Large-bore peripheral and central catheters • Fluid warmer • Pressure bag • Blood products • Rapid infuser 	<ul style="list-style-type: none"> • Video laryngoscope, if available • Laryngoscope blades of alternative design and size • Supraglottic airway devices • Endotracheal tube guides • Retrograde intubation equipment • Nonsurgical airway ventilation device • Topical anesthetics and vasoconstrictors • Cricothyrotomy kit

‡Review AANA *Malignant Hyperthermia Crisis Preparedness and Treatment*⁴⁸ for recommendations

Non-pharmacologic Analgesia

The parturient may select non-pharmacologic pain management modalities alone or with pharmacologic modalities for labor, delivery and post-partum analgesia. Non-pharmacologic techniques include natural childbirth, guided imagery, hydrotherapy, transcutaneous electrical nerve stimulation, acupuncture, hypnosis and doula emotional support.⁴⁹⁻⁵¹ Anesthesia professionals should support and integrate the patient’s choice for non-pharmacologic analgesia into pain management considerations.

Pharmacologic Analgesia

Limited doses of parenteral opioids or agonist/antagonist medications may be used prior to or in place of neuraxial analgesia. However, this analgesic method has little impact on maternal pain compared to neuraxial analgesia, has adverse effects such as nausea and vomiting, and has the potential for placental transfer to the fetus.¹⁴ Patients with conditions such as hepatic and renal diseases, morbid obesity and sleep apnea are more susceptible to opioid respiratory depressant effects. Consider a reduced dose or elimination of opioids with these comorbidities.

Inhalation Analgesia

Nitrous oxide combined with oxygen provides rapid onset pain relief (approximately 30-50 seconds), making it more popular for managing pain in labor.^{52,53} Patients may self-administer nitrous oxide (50 percent with 50 percent oxygen) as patient-controlled or continuous administration.^{53,54} Anesthesia professionals should monitor fetal response to maternal hypoxia and use waste gas scavengers.

Neuraxial Analgesia and Anesthesia for Labor and Delivery

Neuraxial technique(s) may be used to manage pain during labor and delivery and may cause fewer maternal complications and adverse neonatal outcomes associated with general anesthesia.⁵⁵ With adequate time and rapid-acting local anesthetics, a labor epidural may be converted to a surgical anesthetic.

The neuraxial technique is utilized to provide adequate pain relief and/or sensory blockade while preserving motor function, typically achieved by administering a combination of local anesthetics

and opioids, which allows for lower doses of each agent and mitigates adverse side effects and shortens latency. Ideal drugs for labor analgesia provide effective analgesia with minimal motor blockade, minimal risk of maternal and fetal toxicity, and negligible effect on uterine activity and uteroplacental perfusion. Supplementing labor analgesia may be necessary for vaginal delivery, requiring a more concentrated solution of local anesthetic.

Neuraxial Contraindications

Neuraxial analgesia and anesthesia is contraindicated in the following situations:^{14,41,56-58}

- Patient refusal or inability to cooperate.
- Increased intracranial pressure secondary to a cerebral or spinal lesion.
- Skin or soft tissue infection at site of needle placement.
- Coagulopathy.
- Pharmacologic anticoagulation.
- Significant maternal hypovolemia.

Clotting Status

Obstetric patients on anticoagulation therapy (e.g., antiplatelet, anticoagulant) or with platelet dysfunction are at increased risk of developing an epidural/spinal hematoma.⁵⁹ Order and review the following coagulation tests based on a patient's medical history, physical examination, pharmacologic therapy and clinical signs (e.g., preeclampsia):⁶⁰⁻⁶³

- Platelet count.
- Prothrombin time.
- International normalized ratio.
- Activated partial thromboplastin time.
- Activated clotting time.
- Thromboelastography (TEG) if available.

A specific, lower-limit platelet count for adequate clotting prior to placement of a neuraxial catheter or needle has not been established.^{14,61,62,64} When the parturient platelet count is low, weigh the risks and benefits with the patient and obstetric professional to develop the plan for analgesia and anesthesia based on the parturient's overall clinical condition, including coagulation status.⁶¹

- Recommendations to determine the time interval between last dose of anticoagulation therapy and spinal or epidural placement and catheter removal can be found in facility policy and/or *American Society of Regional Anesthesia and Pain Medicine*.^{60,61,65,66}
- Avoid insertion and removal of catheter in the presence of a coagulopathy.⁶⁰

Neuraxial Analgesia Timing

Analgesic requirements may vary during each stage of labor depending on the level of discomfort the parturient experiences. Maternal request in early, active labor is a sufficient indication for pain relief.^{14,41,67} Patients may be treated with neuraxial opioids, local anesthetics, or a combination of them as labor progresses.⁵⁵ Co-administration of an opioid and local

anesthetic synergistic effect reduces the total dose of each medication to provide pain relief and minimize side effects.

Neuraxial technique can be used during labor, vaginal delivery or cesarean section, though agents and dosing will vary. Administration of neuraxial analgesia for patients with co-morbid conditions (e.g., preeclampsia, hypertension, morbid obesity) in the early active labor can help control maternal blood pressure, attenuate hypertensive response to pain, improve placental blood flow, and be prepared for emergent delivery (e.g., patients undergoing TOLAC). Frequent assessment of the patient comfort and labor status provide the anesthesia professional with information necessary to optimize analgesia, patient trust and progress of labor.

Neuraxial technique may be administered by an epidural, spinal, combined spinal epidural and dural puncture epidural, described below in Table 2.

Table 2. Description of neuraxial techniques⁴⁶

Method	Description and Considerations
Epidural	<ul style="list-style-type: none"> • Intermittent and continuous epidural administration of medications. • Identify epidural space using appropriate technique (e.g., loss-of-resistance with saline). • Thread the epidural catheter into the space 3-5 cm and remove needle securing the catheter in place. <ul style="list-style-type: none"> ○ Slightly more depth of up to 7cm is acceptable in obese patients. • Administer the test dose prior to administration of a bolus or an infusion. • Administer single bolus dose, intermittent bolus infusion, patient-controlled bolus infusion, or continuous infusion of local anesthetic and/or opioid for flexible maintenance of labor analgesia.
Spinal (Intrathecal Injection)	<ul style="list-style-type: none"> • Consider for patients who require analgesia or anesthesia shortly before anticipated vaginal delivery, in settings where epidural analgesia is not possible and for surgical indications. • Use pencil-tip, 25-27-gauge spinal needle and consider using introducer needle. • Administer intrathecal local anesthetic and/or opioid.
Combined Spinal-Epidural	<ul style="list-style-type: none"> • Identify lumbar epidural space (e.g., loss-of-resistance with saline) and insert spinal needle through lumen of epidural needle. • Once intrathecal placement is noted, administer desired medications into the subarachnoid space and remove spinal needle. • Thread the epidural catheter into the space 3-5 cm and remove needle securing the catheter in place. <ul style="list-style-type: none"> ○ Slightly more depth of up to 7cm is acceptable in obese patients. • Administer the test dose prior to administration of a bolus or an infusion. • Administer single bolus dose, intermittent bolus infusion, patient-controlled bolus infusion, or continuous infusion of local anesthetic with or without opioid for labor analgesia.

Method	Description and Considerations
Dural Puncture Epidural⁶⁸	<ul style="list-style-type: none"> • Use same technique as described for the combined spinal-epidural technique for placement of epidural and spinal needle. • Omit administration of any medication into the subarachnoid space.

Neuraxial Insertion Preparation

Prepare the patient for neuraxial analgesia and anesthesia by positioning them into a left lateral or sitting position.^{69,70} Preparing the patient’s skin prior to performing neuraxial technique significantly reduces the risk of infection. Follow manufacturer recommendations and facility policy for the proper use of skin prep agents, including dry times. Wipe residual agent and place a sterile drape around insertion site to prevent introducing this solution into the epidural/subarachnoid space.

An ideal skin prep agent should decrease microorganism count, inhibit rebound and regrowth of microorganisms, activate quickly and be effective against a variety of microorganisms.^{71,72} Each agent has a specific mechanism of action along with specific advantages and disadvantages that should be weighed in all clinical situations.⁷¹ Chlorhexidine gluconate (CHG) is the preferred skin prep agent due to immediate action, residual activity and persistent effectiveness against a wide range of microorganisms, but povidone-iodine and iodine base with alcohol are suitable alternatives when CHG is contraindicated.⁷¹ The patient’s allergies, skin condition, and other contraindications as well as the site of the procedure should be considered prior to applying the agent.

The skin is prepped prior to the procedure following the facility policy and manufacturer’s recommendations for the proper use of the skin prep agent, including contact and drying times.⁴² If contact time has been reached, wipe residual agent, and place the sterile drape around insertion site to prevent infection and contamination of the epidural or subarachnoid space.

Ultrasound Guidance

Ultrasound guidance for the pre-procedure mapping of anatomy is a useful adjunct for patients who are difficult to visualize or palpate anatomic landmarks, have poor back flexion, scoliosis or lordosis, or history of difficult neuraxial block placement.^{70,73-76} Ultrasound guidance facilitates neuraxial anesthesia placement, successful block and reduces the risk of inadvertent dural puncture. Research has confirmed that identification of midline and intervertebral spaces is more accurate with ultrasound than with landmark palpation and provides an excellent correlation between ultrasound-measured depth and needle insertion depth to the epidural or intrathecal space.⁷⁷

Circulating Volume

Insert and maintain large bore venous access and intravenous infusion to administer medication; maintain circulating volume and hemodynamic status.¹⁹ Crystalloid solution may be administered (preload or coload) to limit hypotension during neuraxial analgesia/anesthesia.⁷⁸ If volume needs to be limited due to cardiac, renal or other concerns, sympathomimetic agents,

excluding epinephrine, may be used in combination with fluid therapy.^{48,49} Hypotension should be treated with appropriate doses of vasopressors.⁷⁸

Epidural Catheter Test Dose

An epidural test dose of local anesthetic, with or without epinephrine, is a method administered to ascertain if the catheter has been inadvertently placed.⁷⁹⁻⁸¹ A common mixture for test dose is 3ml of 1.5 percent lidocaine with epinephrine 1:200,000. A positive intravascular test dose is indicated by a 20 beat per minute increase in heart rate within 45 seconds of the dose if epinephrine is used. Circumoral numbness or tinnitus may also be observed in response to local anesthetic injected intravascularly. Subarachnoid placement is indicated by rapid onset sensory and motor blockade with or without hypotension.⁸² Potential adverse effects of the test dose may include heart palpitations, tachycardia, tachydysrhythmias, hypotension, motor blockade, and, in rare cases, seizures.⁷⁹ The epidural catheter is aspirated gently prior to administration of medication to verify the absence of blood or cerebrospinal fluid.⁸³ Following the epidural test dose, assess blood pressure every five minutes after each bolus dose for the first 15-30 minutes or longer if there are hemodynamic changes.⁸⁰

Patient-Controlled Epidural Analgesia Considerations

The following steps should be taken to ensure safe patient-controlled epidural analgesia (PCEA) administration to patients:

- Develop PCEA patient selection criteria
 - Evaluate use of PCEA for all patients, especially those with comorbidities who are at increased risk of respiratory depression (e.g., obesity, asthma, sleep apnea or medication therapy that may potentiate opioids).⁸⁴
- Monitor patients receiving PCEA
 - Evaluate patient's level of pain (utilize standard scale), alertness (minimal response to verbal or tactile stimuli), vital signs, respiratory rate and quality of respirations according to facility policy.^{84,85}
 - Continuous use of pulse oximetry to monitor oxygenation and technology to monitor respiration (e.g., capnography, acoustic monitoring) according to facility policy.⁸⁴ In patients with risk factors for respiratory depression (e.g., obesity, asthma, sleep apnea or medication therapy that may potentiate opioids), consider continuous monitoring of capnography.
- Inform patients and staff of concerns regarding PCEA by proxy
 - Teach staff, patients and family members the correct use of PCA and the risk of others pressing the button for the patient (PCEA by proxy).
 - Place warning labels on all PCEA delivery equipment. Example of a label includes: "*only the patient should press this button.*"⁸⁶

Monitoring

Monitoring standards for the obstetric patient vary based on the patient's health status and labor analgesic technique. Basic monitoring includes maternal blood pressure, heart and respiratory rate, peripheral oxygen saturation and fetal heart rate.² High-risk patients may also require electrocardiogram and arterial blood pressure monitoring.⁸⁷ Refer to facility policy for monitoring recommendations for patients receiving obstetric analgesia and anesthesia. Refer to AANA *Care of Patients Receiving Analgesia by Catheter Techniques*⁸⁸ for guidance on monitoring patients receiving analgesia through various catheter techniques.

General Anesthesia

General anesthesia may be necessary for a cesarean section or other obstetric surgical emergency. Indications for general anesthesia include, but are not limited to, inability to place neuraxial anesthesia, inadequate neuraxial anesthesia, patient refusal of neuraxial anesthesia, severe maternal hemorrhage, sustained fetal bradycardia, fetal compromise, eclampsia with elevated intracranial pressure, or severe thrombocytopenia.⁸⁹

General anesthesia for the obstetric patient is outlined below.⁴⁶

1. Maintain left uterine displacement.
2. Provide prophylaxis for gastric aspiration. This may include non-particulate antacid orally, histamine-2 receptor antagonists, proton pump inhibitors, metoclopramide, or other agents alone or in various combinations, given with appropriate lead time for full effect prior to induction.
3. Take precautions to prevent surgical site infections:^{90,91}
 - a. Administer antibiotic prophylaxis 0-30 minutes before skin incision.
 - b. Antibiotic should be redosed when appropriate for a surgical procedure lasting more than two to three hours or when there is significant blood loss.
 - c. If the patient is receiving antibiotics preoperatively, discuss dosing with the surgeon.
 - d. Maintain normothermia.
4. Before induction, preoxygenate and verify the abdomen is prepped and draped, and that the surgeon and team are ready for incision.
5. Airway Management:
 - a. Preoxygenate patient during skin prep and placement of monitors, rapid sequence induction with cricoid pressure.
 - b. Consider videolaryngoscopy to provide optimal, initial view for successful intubation.⁹²
 - c. Coordinate with surgeon such that skin incision takes place during the peak effect of the anesthetic induction drug.
 - d. Use low concentrations, 1 MAC or less of isoflurane, sevoflurane or desflurane to maintain anesthesia.
6. After delivery of the neonate:
 - a. Administer bolus and/or continuous infusion of oxytocin, avoiding large boluses or rapid infusions⁹³; consider other uterotonic agents as directed by surgeon. Take precautions to prevent hypotension.
 - b. Decrease volatile agent to minimize uterine atony.

Post-Cesarean Analgesia

Multimodal postoperative pain management, as an element of enhanced recovery after surgery, is important for the immediate and long-term success of patients undergoing cesarean section. Appropriately managed postoperative pain optimizes the mother's ability to be mobile, care for her neonate and breastfeed.⁹⁴ Inappropriately managed pain may increase the risk of post-partum depression, thromboembolic event and dependence on opioids that may lead to substance use disorder and chronic pain development.⁹⁵⁻⁹⁸

Multiple studies have demonstrated that neuraxial opioids administered as part of the surgical anesthetic provide superior postoperative analgesia when compared with intravenous opioids. Intravenous opioids may be administered if an opioid was not added to the neuraxial technique or if breakthrough pain occurs with a neuraxial technique.

Multimodal analgesia, which includes the combination of several medications with different mechanisms of action, may enhance the effects of a single analgesic and reduce opioid requirements and opioid-related side effects.^{96,99,100} A combination of the minimum effective dose of opioid or no opioid, in combination with a non-steroidal anti-inflammatory drug (NSAID), acetaminophen, and dexamethasone provides optimal pain relief.^{101,102} A combination of these agents may produce additive or synergistic effects to decrease medication doses, reducing the side effects and the transfer of medication into breast milk. Administer dexamethasone and intravenous acetaminophen after cord clamp.

Adjuncts to neuraxial anesthetic technique may be administered for cesarean delivery. Utilizing a multimodal approach for surgical analgesia that may include opioids, nerve block (e.g., transversus abdominis plane block, Ilioinguinal-Iliohypogastric block) for cesarean delivery and in the post-partum period. A sub-anesthetic intravenous dose of Ketamine following cesarean section may improve analgesia but does not significantly reduce the risk of persistent post-surgical pain.^{103,104,105}

Individualize the multi-modal pain management plan on overall patient condition. For example, a patient with a history of long-term opioid use, substance abuse or substance use disorder may benefit from the addition of gabapentin, local anesthetics and/or ketamine, and nerve blocks and local wound infiltration.^{103,106,107} Additionally, implementing enhanced recovery after surgery protocols can improve recovery time. *AANA Enhanced Recovery After Surgery*¹⁰⁸, discusses development and implementation of these protocols in more depth. Table 3 provides an exemplar of multimodal pain management considerations, which should be tailored to individualized to each patient.

Table 3. Exemplar multimodal pain management therapy considerations

Drug Class	Agent	Route	Dose	Frequency/ Duration of Effect	Considerations
Neuraxial Opioids	Morphine ^{101,102,109}	Neuraxial	0.1 - 0.2mg (spinal) 2 - 3.75 mg(epidural)	1x/12-24hours duration	
	Fentanyl ^{*110}	Neuraxial	10-20 mcg (spinal) 50-100 mcg (epidural)	1x/3-4 hours duration	
	Hydromorphone ^{*111}	Neuraxial	100 mcg (spinal)	1x/6-24hours duration	Can utilize if morphine is contraindicated
Systemic Opioids	Morphine ¹¹²	IV PCA	1-1.5mg	7 min lockout	Rescue dose 2 mg IV q 5 min (up to 3 doses)
	Fentanyl ¹¹²	IV PCA	20 mcg	7 min lockout	Rescue dose 25 ug IV q 5 min (up to 3 doses)
	Hydromorphone ¹¹²	IV PCA	0.1 mg	7 min lockout	Rescue dose 0.3mg IV q 5 min (up to 3 doses)
NSAID	Ketorolac ¹¹³	IV	30mg (not to exceed 90mg/day)	q8hrs	Discontinue once oral ibuprofen can be taken Safe for nursing mothers ¹¹⁴ Contraindicated in renal impairment, peptic ulcer disease or increase risk for hemorrhage

Drug Class	Agent	Route	Dose	Frequency/ Duration of Effect	Considerations
	Ibuprofen ¹¹⁵	PO	600-800mg	q8hrs	Administer 2-3 days via fixed schedule ¹¹⁵
Central Acting Analgesic	Acetaminophen ^{116,117}	IV	1g (not to exceed 4 g/day)	q6hrs	Discontinue once oral acetaminophen can be taken
	Acetaminophen	PO	650mg	q6hrs	
Corticosteroid	Dexamethasone ¹¹⁸	IV, following umbilical cord clamp	8-10mg	1x/24 hours duration	
<i>N</i> -methyl- <i>D</i> -aspartate	Ketamine ^{103,104}	IV	10 mg or 0.15 mg/kg	1x pre-operative/24 hours duration	Administer after neuraxial anesthesia placed, but prior to surgery start
Local Anesthetic	Bupivacaine; Ropivacaine ^{107,119,120}	TAP Block	0.25 -0.375 percent Bupivacaine (not to exceed 3mg/kg) 0.375-0.5 percent Ropivacaine (not to exceed 2.5mg/kg)	1x/12hrs duration	Careful not to exceed toxic doses in smaller patients

Drug Class	Agent	Route	Dose	Frequency/ Duration of Effect	Considerations
Anticonvulsant	Gabapentin ¹⁰⁶	Oral	600mg	1x pre-operative (1 hour prior to surgery)/6-48hours duration	

Tubal Sterilization

Considerations for scheduling the tubal sterilization procedure include maternal and neonatal health status; the timing of the procedure (during cesarean or as a separate procedure later); and if required consent(s) are complete. Take steps to prevent aspiration pneumonitis, detailed in the side effects section below. The anticipated length of the procedure will guide the selection of local anesthetic. Table 4 describes various technique considerations for tubal sterilization.

Table 4. Tubal sterilization techniques⁴⁶

Spinal	<ul style="list-style-type: none"> • Small-gauge, non-cutting, pencil point needle (25-27 gauge). • Assess for bilateral T-4 sensory level.
Epidural	<ul style="list-style-type: none"> • Verify proper placement of the epidural and test dose the catheter. • Assess for bilateral T-4 sensory level.
General Anesthesia	<ul style="list-style-type: none"> • Administer sodium citrate. • Rapid sequence induction with cricoid pressure.

Removal of Retained Placenta

If the placenta is not delivered with 30-60 minutes of birth, manual removal may be necessary. The administration of oxytocin and clamping and cutting the umbilical cord promptly after delivery may contribute to retained placenta.^{121,122} Analgesia and anesthesia for removal is dependent on patient hemodynamic status and rate of blood loss. Collaborating with the obstetric professional, small doses of intravenous nitroglycerin (e.g., 40 micrograms) and analgesics may facilitate manual extraction of retained placenta. Epidural or spinal anesthesia may be considered for patients who are hemodynamically stable.¹²¹ General anesthesia may be necessary if blood loss cannot be controlled.

Preventing and Managing Analgesia and Anesthesia Side Effects and Complications

Placement of neuraxial block, administration of opioids and general anesthesia can result in side effects and complications. Considerations to address side effects and complications are described below.

*Inadequate Analgesia*⁴⁶

- Assess progress of labor and rule out other causes of pain.
- Evaluate catheter position to ensure it is not obviously dislodged. Note that an unchanged skin marking does not guarantee that the catheter tip remains in the epidural space.
- *If the extent of neuroblockade is inadequate:*
 - Consider fetal malpresentation, full bladder, placental abruption, uterine rupture or other causes.
 - Inspect catheter site and withdraw one centimeter and resecure.
 - Inject a large volume (e.g., 5-15 ml volume of a dilute local anesthetic solution given in 5 ml aliquots) of dilute solution of local anesthetic, with or without an opioid.
 - Alter maintenance technique (e.g., change local anesthetic or increase concentration used, increase epidural infusion rate).
 - If maneuver is unsuccessful, replace the catheter.
- *If block is asymmetric:*
 - Place the less-blocked side in the dependent position.
 - Inspect catheter site and withdraw 1 cm, as long as an adequate depth of catheter would remain in the epidural space (3 cm for multi-orifice catheters or 2 cm for single orifice) and resecure
 - Inject a large volume of dilute solution of local anesthetic, with or without an opioid.
 - Alter maintenance technique (e.g., increase volume, decrease concentration).
 - If maneuver is unsuccessful, replace the catheter.
- *If catheter is in the epidural space, but there is breakthrough pain:*
 - Inspect catheter site and withdraw one centimeter and resecure.
 - Inject a large volume of dilute solution of local anesthetic, with or without an opioid.
 - Alter maintenance technique (e.g., increase volume, decrease concentration).

Hypotension^{123,124}

- Assess for potential causes (such as aortocaval compression, high block, bleeding).
- Administer IV fluid bolus.
- Administer vasopressor.
- Consider administering ondansetron* at the time of spinal injection part of spinal-induced hypotension prophylaxis
- Place patient in full lateral and Trendelenburg position.

Pruritus^{125,126}

Opioid-induced pruritus may be generalized or localized in regions. Prevent and treat pruritus with pharmacologic treatments such as opioid antagonists (e.g., naloxone* infusion, oral naltrexone*), opioid agonist/antagonist (e.g., nalbuphine* infusion), 5-HT₃ receptor antagonist (e.g., ondansetron*), or other appropriate therapy.

Nausea and Vomiting¹²⁷⁻¹²⁹

Prevent and treat with the following:

- Metoclopramide
- Ondansetron
- Scopolamine
- Cyclizine
- Dexamethasone

Urinary Retention⁴⁶

- Observe patient for evidence of bladder distention, especially if she complains of suprapubic pain during contractions.
- Inability to void and bladder distention should prompt bladder catheterization.

Inadvertent Dural Puncture

- Disclose to patient and discuss steps for management.
 - Perform neuraxial technique following dural puncture with epidural needle:¹³⁰⁻¹³²
 - Thread the catheter into the subarachnoid/ intrathecal space and leave in place for at least 24 hours
 - Clearly label spinal catheter at the syringe/infusion end and communicate with all anesthesia providers that catheter is intrathecal
- OR**
- Repeat the epidural procedure and reinsert an epidural catheter in a different level
 - Assess for intrathecal block

Post Dural Puncture Headache¹³¹⁻¹³³

Take steps to prevent post-dural puncture headache, assess the patient for post-dural puncture headache, which may occur 16-24 hours after puncture, and manage, as outlined below.

Prevention

- Use small, non-cutting spinal needle (e.g., 25-27 gauge)
- Use ultrasound to provide guidance on patients with a difficult-to-palpate spine
- Encourage patient to hydrate, including caffeine beverages if tolerated, increase salt intake

Management

- Analgesics
- Caffeine IV
- Sumatriptan
- Adrenocorticotrophic hormone
- Horizontal position
- Epidural blood patch may be considered if other measures do not alleviate post-dural puncture headache
- Intrathecal catheter placement

Aspiration Pneumonitis

Take precautions to prevent aspiration pneumonitis during pregnancy, labor, delivery, surgery and post-delivery.¹³⁴ Medications (e.g., clear antacid, histamine-2 receptor antagonist, Metoclopramide) and restricting solid foods before elective surgery can help prevent aspiration.^{135,136} Manage cases of aspiration pneumonitis on an individual basis.⁴⁶

Complication and Emergency Management

Facilities prepare for obstetric complications and emergencies through the use of standardized protocols, use of emergency checklists for both team training and the actual emergency, and timely availability to emergency equipment and supplies.¹³⁵⁻¹³⁷ Standardization of care through clinical pathways, emergency checklists and bundles limits variation in care to improve delivery of care, safety and patient outcomes.¹³⁸⁻¹⁴¹

Emergency resources include, but are not limited to:

- [American College of Obstetricians and Gynecologists \(ACOG\) Hypertension Bundle](#)
- [ACOG Hemorrhage Bundle](#)
- [ACOG Venous Thromboembolism Bundle](#)
- [ACOG Committee Opinion, Opioid Use and Opioid Use Disorder in Pregnancy](#)
- [American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care](#)
- [The Society for Obstetric Anesthesia and Perinatology consensus statement on the management of cardiac arrest in pregnancy¹⁴²](#)
- [California Maternal Quality Care Collaborative Preeclampsia Toolkit](#)
- [California Maternal Quality Care Collaborative Obstetric Hemorrhage Toolkit](#)
- [American Society of Regional Anesthesia and Pain Medicine Advisories and Guidelines](#)
- [Society for Obstetric Anesthesia and Perinatology Guidelines and Resources](#)
- [Emergency Manuals Implementation Collaborative \(EMIC\)](#)

Rapid Response Team

Establishing a rapid response team can improve management of obstetric and fetal complications and emergencies, which may lead to improved maternal, fetal and neonatal outcomes.^{135,143} An obstetric rapid response team is composed of healthcare professionals who train together to respond to early signs of obstetric, fetal and neonatal emergencies. A rapid response team may include, but not be limited to, an in-house obstetric professional, anesthesia

professional, labor and delivery registered nurse, operating room registered nurse, neonatal professional(s), respiratory therapist, and other clinical specialists as indicated.^{135,143,144} Policy and criteria to activate the rapid response team is developed and improved by the department of obstetrics team.

A review of emergency incidents is part of a continuous quality improvement program to provide an opportunity for the interprofessional team to assess performance and outcomes and to make recommendations for team education and process improvement.¹⁴⁴ Low fidelity and/or simulation lab rapid response team drills every six months are valuable in low and high volume units. In addition, facilities should implement policies to determine roles and responsibilities related to neonatal resuscitation. Specific policies will be based upon staff availability and education within each facility.

Difficult Airway Management

An anesthesia professional may be required to address airway emergencies during the entire peripartum period. Several physiologic and anatomic changes occur during pregnancy and should be considered when addressing ventilation and airway management of the parturient. They include airway edema, weight gain, enlarged breasts, decreased lower esophageal sphincter tone and decreased gastric emptying, increased oxygen consumption, and decreased functional residual capacity.¹⁴⁵

In the event that an airway emergency occurs, the first priority is effective ventilation for maternal and fetal oxygenation.¹⁴⁵ Considerations specific for the parturient airway include use of a short laryngoscopy handle, placing the standard laryngoscope parallel to the cheek to insert the laryngoscope blade into the oropharynx, video laryngoscopy, a gum elastic bougie and/or a 6 mm endotracheal tube.¹⁴⁵ Mask ventilation with cricoid pressure to maintain oxygenation should be considered in the scenarios described in Table 5.¹⁴⁵ Cricoid pressure may not be effective, and if ventilation or airway visualization is inadequate, consider removing cricoid pressure.

Table 5. Obstetric airway emergency scenario considerations^{145,146}

Scenario	Considerations
Can Ventilate Cannot Intubate	<ul style="list-style-type: none"> • Assess maternal and fetal status. • Mother and fetus at immediate risk. <ul style="list-style-type: none"> ○ Continue ventilation until patient emerges and consider neuraxial technique or awake intubation <li style="text-align: center;">OR ○ Continue anesthesia with mask ventilation with cricoid pressure assessing quality of ventilation and need for insertion of a supraglottic airway device or surgical airway. • Mother or fetus in immediate danger. <ul style="list-style-type: none"> ○ Proceed to cesarean section with mask ventilation, cricoid pressure and determine if repeated intubation attempt is appropriate.

Scenario	Considerations
	<ul style="list-style-type: none"> ○ If not able to intubate, consider supraglottic device with gastric drainage port.
Cannot Ventilate or Intubate	<ul style="list-style-type: none"> ● Insert supraglottic airway device with gastric port. ● Needle cricothyrotomy with transtracheal jet ventilation, retrograde intubation. ● Emergency cricothyrotomy or tracheostomy.

Hypertensive Disorders

Hypertension in the parturient patient may represent pre-existing chronic hypertension, gestational hypertension or pregnancy-induced hypertension, also known as pre-eclampsia. Appropriate management of hypertension requires prompt recognition, evaluation and treatment to prevent permanent end-organ damage. Hypertension is defined as having a blood pressure above 140 mmHg/90 mmHg. Severe hypertension is a systolic blood pressure above 160 mmHg or diastolic blood pressure above 110 mmHg.

The following laboratory tests may be of value to identify the systemic effects of hypertension and to guide management.

- Complete blood count
- Platelet count
- Lactate dehydrogenase
- Liver Function Test
- Electrolytes
- BUN, creatinine
- Urine protein

Hypertensive disorders leading to preeclampsia, eclampsia, and HELLP syndrome (hemolysis, elevated liver enzymes and low platelet count) warrant careful evaluation and management before neuraxial analgesia or anesthesia is implemented. Table 6 describes the characteristics of hypertensive disorders.

Table 6. Characteristics of hypertensive disorders¹⁴⁷⁻¹⁴⁹

Disorder	Diagnostic Criteria and Characteristics
Chronic Hypertension	<ul style="list-style-type: none"> ● Systolic blood pressure (SBP) greater than or equal to 140 mm Hg or diastolic blood pressure (DBP) greater than or equal to 90 mm Hg. ● Onset prior to pregnancy or less than 20 weeks gestation.
Gestational Hypertension	<ul style="list-style-type: none"> ● SBP greater than or equal to 140 mm Hg or DBP greater than or equal to 90 mm Hg. ● Onset at 20 weeks gestation, most cases develop at and after 37 weeks gestation.¹⁵⁰ ● Absence of proteinuria or systemic signs/symptoms.
Pre-eclampsia	<ul style="list-style-type: none"> ● Risk factors:

Disorder	Diagnostic Criteria and Characteristics
	<ul style="list-style-type: none"> ○ Preeclampsia in a previous pregnancy ○ Multiparity ○ Pre-existing hypertension, diabetes, renal disease, vascular and connective tissue diseases ○ BMI greater than 35 ● Diagnostic criteria: <ul style="list-style-type: none"> ○ SBP between 140 and 159 mmHg ○ DBP between 90 and 109 mmHg ○ Evidence of organ dysfunction and lab abnormalities ● Symptoms: <ul style="list-style-type: none"> ○ Urine output: 30-49 ml/hour ○ Mild headache ○ Blurred or impaired vision ○ Nausea, vomiting, abdominal pain ○ Chest pain ○ Depression of patellar reflexes ● Lab values: <ul style="list-style-type: none"> ○ Platelet count: 50,000 -100,000 per microliter of blood ○ AST/ALT: 1-2 times normal value ○ Category II intrauterine fetal growth restriction ○ Creatinine: 0.9-1.1 ○ Proteinuria: new onset 300mg/24 hours or worsening proteinuria*
Pre-eclampsia with Severe Features	<ul style="list-style-type: none"> ● SBP greater than or equal to 160 mm Hg or DBP greater than or equal to 110 mm Hg obtained 15-60 minutes apart. ● Persistent oliguria < 500 ml/24 hours. ● Progressive renal insufficiency. ● Lab values: <ul style="list-style-type: none"> ○ Platelet count: less than 100,000 per microliter of blood ○ AST/ALT: greater than 2 times normal value ○ HELLP Syndrome: hemolysis, elevated liver enzymes, thrombocytopenia ● Symptoms: <ul style="list-style-type: none"> ○ Unrelenting headache ○ Partial blindness or blind spots ○ Epigastric or RUQ pain ○ Pulmonary edema ○ Urine output: less than 30 ml/hour ● Category III: <ul style="list-style-type: none"> ○ Creatinine: greater than 1.2 ○ Proteinuria: greater than 500 mg/24 hours* ○ Nausea, vomiting, abdominal pain ○ Chest pain ○ Respiratory rate less than 12/minute

Disorder	Diagnostic Criteria and Characteristics
Eclampsia	<ul style="list-style-type: none"> • Preeclampsia with severe features plus: <ul style="list-style-type: none"> ○ Grand-mal seizures ○ Unconsciousness ○ Comatose

***Proteinuria not required for diagnosis of preeclampsia**

Hypertension Management

Pregnant or postpartum women with acute-onset, severe hypertension require antihypertensive therapy. The goal is to achieve a blood pressure range of 140-160 mmHg systolic and 90-100 mmHg diastolic to prevent repeated, prolonged exposure of the patient to significant hypertension with subsequent loss of cerebral vasculature autoregulation.¹⁵¹⁻¹⁵³ Close maternal and fetal monitoring are advised during the treatment of acute-onset, severe hypertension, and judicious fluid administration is recommended even in the case of oliguria. Table 7 provides therapeutic recommendations for treatment of maternal hypertension and anticonvulsant prophylaxis and management.

Table 7. Hypertension therapy and seizure prophylaxis and management^{147,151}

Antihypertensive Medications
<p>Labetalol</p> <ul style="list-style-type: none"> • 20, 40, 80 mg IV escalating doses titrated over 2 minutes, repeat every 10 minutes; avoid in patients with asthma or heart failure. • 200 mg oral, if no IV access; repeat in 30 minutes if needed. <p>Hydralazine</p> <ul style="list-style-type: none"> • 5-10 mg IV over 2 minutes, repeat every 20 minutes until target blood pressure is reached. <p>Oral Nifedipine</p> <ul style="list-style-type: none"> • 10, 20, 40 mg capsules; repeat blood pressure readings and medication doses every 20 minutes until target blood pressure reached. • Capsules should be administered orally, not punctured or administered sublingually. <p>Sodium Nitroprusside</p> <ul style="list-style-type: none"> • 0.25 to 5 mcg/kg/min IV infusion (risk of fetal cyanide toxicity if used > 4 hours). <p style="text-align: center;">Magnesium sulfate should be used for seizure prophylaxis and treatment, and is not recommended as an anti-hypertensive agent.</p>
Anticonvulsant Prophylaxis Management¹⁵⁴
<p>Anticonvulsant Prophylaxis and Management</p> <ul style="list-style-type: none"> • Intravenous Magnesium Sulfate (20 g/500ml bag) <ul style="list-style-type: none"> ○ 5-10 mg every 15-20 minutes. ○ Contraindicated in pulmonary edema, renal failure, myasthenia gravis.

Magnesium Overdose Management

- **Intravenous Calcium Gluconate (1000 mg/10 ml vial over 2-5 minutes).**

For recurrent seizures or when magnesium sulfate is contraindicated

- **Intravenous Lorazepam**
 - 2-4 mg IV x 1, may repeat x 1 after 10-15 min.
- **Intravenous Diazepam**
 - 5-10 mg IV every 5-10 min to max dose 30 mg.

Seizure Management

- Maintain airway patency and breathing
- Position patient on side, protect patient from injury.
- Assess neurologic function.
- Provide acute seizure control with IV propofol, midazolam, or phenytoin.
- Following seizure:
 - Clear oropharynx
 - Oxygenate, monitor oxygen saturation
 - Intubate and ventilate, as indicated

Analgesia and Anesthesia Considerations for Patients with a Hypertensive Disorder

- Continuously monitor patient blood pressure (e.g., automatic blood pressure cuff, arterial line)
- *Neuraxial analgesia and anesthesia*
 - Neuraxial technique is preferred for vaginal delivery and cesarean section unless contraindicated.
 - Consider early neuraxial analgesia to optimize timing of epidural catheter placement in setting of declining platelet count and improve uteroplacental perfusion.
 - Spinal anesthesia may result in improved outcomes due to reliability and simplicity of technique, rapid onset, reliability, lower dose of local anesthetic and less risk of epidural venous trauma.¹⁵⁵
- *General anesthesia*
 - Clinical indications include severe maternal hemorrhage, sustained fetal bradycardia, severe thrombocytopenia or other coagulopathy.
 - Pre-emptively address anticipated hypertensive response to airway instrumentation and intubation.
 - Induction of general anesthesia and intubation should not occur without first taking steps to eliminate or minimize the hypertensive response to intubation.
- *Eclampsia*⁸⁹
 - Consider neuraxial technique for eclamptic patients with no evidence of increased intracranial pressure and well-controlled seizures.

- Consider general anesthesia for eclamptic patients with elevated intracranial pressure.
- *Postpartum*
 - Monitor blood pressure until stable.
 - Do not administer NSAIDs for hypertensive patient.

Obstetric Hemorrhage

Obstetric hemorrhage is defined as severe bleeding during pregnancy, labor or in the postpartum period that may become life-threatening.^{156,157} Risk factors for obstetric hemorrhage include, but are not limited to:^{158,159}

- Patient history
 - Prior cesarean, uterine surgery or multiple laparotomies.
 - History of obstetric hemorrhage.
 - BMI over 40.
 - Multiparity, especially greater than four prior births.
 - Multiple gestation.
 - Estimated fetal weight greater than 4,000 grams.
 - Coagulopathy, bleeding disorder or active bleeding.
- Placental and Uterine
 - Placenta previa/low lying, accrete, increta or percreta.
 - Placental abruption.
 - Chorioamnionitis.
 - Large uterine myoma.
- Labor-related
 - Induction of labor greater than 24 hours.
 - Prolonged second stage of labor.
 - Magnesium sulfate.

Antepartum hemorrhage is defined as bleeding from or into the genital tract, which can occur any time during pregnancy, until childbirth. If not addressed, antepartum hemorrhage can result in postpartum hemorrhage.¹⁶⁰ Antepartum hemorrhage can be related to several conditions summarized in Table 8.

Table 8. Presentation of antepartum hemorrhage^{157,158}

Condition	Presentation
Placenta Previa	<ul style="list-style-type: none"> ● Present when placenta implants in advance of fetal presenting part. <ul style="list-style-type: none"> ○ Total placenta previa - completely covers cervical os. ○ Partial placenta previa - covers part, but not all, of cervical os. ○ Marginal placenta previa - lies close to, but does not cover, the cervical os. ● Painless vaginal bleeding during second or third trimester. ● Blood clots expressed from vagina. ● Mild early contractions, normal uterine resting tone, no uterine tenderness.

Condition	Presentation
Placental Abruption	<ul style="list-style-type: none"> • Complete, partial or marginal separation of the placenta from the decidua basalis before delivery. • Vaginal bleeding may be present or may be concealed behind the placenta. • May be associated with a significant amount of pain
Uterine Rupture	<ul style="list-style-type: none"> • A uterine wall defect that results in fetal compromise or maternal hemorrhage sufficient to require a cesarean delivery or postpartum laparotomy. Usually associated with prior cesarean delivery or uterine surgery. • A uterine scar dehiscence is more common and does not result in fetal heart rate abnormalities or excessive hemorrhage and does not require a cesarean delivery or postpartum laparotomy.
Vasa Previa	<ul style="list-style-type: none"> • Velamentous insertion of the fetal vessels over the cervix os. • Bleeding with rupture of the membranes, particularly if accompanied by FHR decelerations or fetal bradycardia.

Postpartum hemorrhage is defined as vaginal delivery with greater than 500 ml of estimated blood loss (EBL) or a cesarean delivery with greater than 1000 ml EBP.^{157,160} Postpartum hemorrhage is related to one or more of four conditions:^{156,160}

1. Uterine atony (tone)
2. Retained placental products (tissue)
3. Genital tract trauma (e.g., trauma)
4. Coagulation abnormalities (e.g., thrombin)

Management of Obstetric Hemorrhage

Obstetric hemorrhage is best managed by a stepwise, systematic approach.¹⁶⁰ Early recognition and management of hemorrhage limits blood loss, decreases the need for blood products, and decreases the risk related blood transfusion complications, including disseminated intravascular coagulation.^{160,161} The use of a checklist as a cognitive aid for team training and during the management of a hemorrhagic emergency, such as the ACOG Obstetric Hemorrhage Checklist, has been shown to improve team communication and outcomes (refer to Appendix A for more detailed information).¹³⁶ Steps and considerations for anesthesia management of obstetric hemorrhage include:

- Large bore vascular access; consider arterial line.
- Initiate systematic approach to manage hemorrhage, such as facility Massive Transfusion Protocol (MTP) blood products and factors.¹⁶²
 - Review *Appendix B, ACOG Bundle on Obstetric Hemorrhage: Mass Transfusion Protocol*.
- Lab tests as indicated for management.
- Anesthesia:
 - Consider neuraxial technique if the parturient and fetus are stable.

- Consider general anesthesia for active maternal hemorrhage, coagulopathy, or fetal distress.

Cardiac Arrest

Maternal cardiac arrest requires an organized, coordinated effort by clinicians of numerous specialties.¹⁶³ Risk factors for cardiac arrest during pregnancy include pregnancy-induced hypertension, sepsis, venous thromboembolism, amniotic fluid embolism, hemorrhage, trauma, iatrogenic causes, and pre-existing heart disease.^{164,165} Increases in cardiac arrest are associated with obstetric patients of advanced maternal age and/or chronic health conditions.¹⁶⁶⁻¹⁷⁰

Rapid recognition and response to a cardiac arrest can be critical in improving the outcomes for both the mother and the fetus.¹⁶⁴ Modifications to cardiac resuscitation for pregnant women include more aggressive airway management, attention to lateral displacement of the uterus, caution in use of sodium bicarbonate, and early consideration of cesarean delivery.¹⁶⁵ It is essential that oxygenation and ventilation are quickly restored while maintaining cricoid pressure.¹⁶⁵

Fetal outcome is related to the time from onset of maternal cardiac arrest to delivery and gestational age.¹⁷¹ Since aortocaval compression by the gravid uterus may limit the efficacy of cardiopulmonary resuscitation (CPR), emergency cesarean delivery of the fetus may considerably improve maternal cardiac output.¹⁶⁵ Immediate surgical delivery should be considered if spontaneous circulation does not return after four minutes of cardiopulmonary resuscitation.^{167,169,172} The American Heart Association (AHA) has published guidelines for CPR and advanced cardiac life support algorithm for maternal cardiac arrest, in the link below.^{169,173}

[Review the AHA Advanced Cardiac Life Support Algorithm](#)

Amniotic Fluid Embolism

An amniotic fluid embolism occurs when amniotic fluid and/or debris (e.g., hair, fetal cells) enter the maternal bloodstream, triggering a massive cascade of inflammatory and hemostatic reactions.^{174,175} Patients may experience anxiety, a sense of doom, or a change of mental status before experiencing dramatic symptoms, including abrupt cardiovascular collapse. Signs and symptoms of amniotic fluid embolism include:¹⁷⁴⁻¹⁷⁷

- Fetal distress
- Dyspnea, cough
- Headache
- Chest pain
- Hypotension
- Sudden desaturation, cyanosis
- Sudden tachycardia
- Bronchospasm
- Uterine atony
- Seizures
- Loss of end-tidal carbon dioxide

- Cardiopulmonary arrest
- Coagulopathy
- Pulmonary edema

Management

When amniotic fluid embolism is suspected, it is important to take immediate action. Immediate notification of specialists in neonatology, maternal-fetal medicine, obstetrics, anesthesia and intensive care is warranted in addition to the following:¹⁷⁴⁻¹⁷⁶

- Large bore venous access.
- Aggressive hemodynamic support.
- Left uterine displacement is crucial in resuscitation efforts if the fetus remains in utero.
- Following cardiac arrest, immediately deliver fetus if more than 23 weeks gestation.
- Control and maintain the airway.
- Blood product therapy, consider recombinant factor VIIa to treat disseminated intravascular coagulation (DIC).
- Ventricular assist device, cardiopulmonary bypass or extracorporeal membrane oxygenation may be required.
- Maintain a pulse oximetry value of 94-98 percent.

If disseminated intravascular coagulation (DIC) develops, be vigilant for development of an epidural hematoma if an epidural was recently inserted.

Conclusion

These guidelines present current evidence-based obstetric analgesia and anesthesia practice and safety considerations for healthcare professionals, healthcare facilities and patients. CRNAs have the responsibility to provide holistic patient-centered care aimed at improving maternal and neonatal outcomes. As the science and practice of obstetric analgesia and anesthesia continue to evolve, healthcare professionals must maintain their familiarity with evolving obstetric analgesia and anesthesia practices as they are updated in federal, state and local statutes and regulations, as well as nationally recognized obstetric care practices and guidelines and scientific literature. In addition to the American Association of Nurse Anesthetists, other organizations that promulgate such recognized guidelines include the American Congress of Obstetricians and Gynecologists (ACOG), American Society of

Anesthesiologists (ASA), Society for Anesthesia and Perinatology (SOAP), and American Society of Regional Anesthesia and Pain Medicine (ASRA). As the breadth and depth of obstetric analgesia and anesthesia continues to grow, CRNAs have the opportunity to contribute to this evolving field through research, education, and practice improvement.

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Appendix A. American College of Obstetricians and Gynecologists Maternal Safety Bundle for Obstetric Hemorrhage: Hemorrhage Checklist

Complete all steps in prior stage plus current stage regardless of stage in which patient presents.

Recognition	<input type="checkbox"/> Call for assistance (obstetric hemorrhage team) <input type="checkbox"/> Designate: <ul style="list-style-type: none"> • Team leader • Checklist reader/recorder • Primary RN <input type="checkbox"/> Announce: <ul style="list-style-type: none"> • Cumulative blood loss • Vital signs • Determine stage 	
Hemorrhage Cart	Vaginal <ul style="list-style-type: none"> <input type="checkbox"/> Vaginal retractors, long weighted speculum <input type="checkbox"/> Long instruments (needle holder, scissors, Kelly clamps, sponge forceps) <input type="checkbox"/> Intrauterine balloon <input type="checkbox"/> Banjo curette <input type="checkbox"/> Bright task light <input type="checkbox"/> Procedural instructions Cesarean/Laparotomy <ul style="list-style-type: none"> <input type="checkbox"/> Hysterectomy tray <input type="checkbox"/> #1 chromic or plain catgut suture and reloadable straight needle for B-lynch suture <input type="checkbox"/> Intrauterine balloon <input type="checkbox"/> Procedural instructions (balloon, B-Lynch, arterial ligations) 	
Checklist: Stage 1 Blood loss >500 mL vaginal OR Blood loss >1000 mL cesarean with normal vital signs and lab values	Initial Steps <ul style="list-style-type: none"> <input type="checkbox"/> Ensure 16G or 18G IV access <input type="checkbox"/> Increase IV fluid (crystalloid without oxytocin) <input type="checkbox"/> Insert indwelling urinary catheter <input type="checkbox"/> Fundal massage Medications (see right box) <ul style="list-style-type: none"> <input type="checkbox"/> Increase oxytocin, additional uterotonics Blood Bank <ul style="list-style-type: none"> <input type="checkbox"/> Type & crossmatch 2 units RBCs Action <ul style="list-style-type: none"> <input type="checkbox"/> Determine etiology & treat 	Medications: <ul style="list-style-type: none"> • Oxytocin (Pitocin) <ul style="list-style-type: none"> ○ 10-40 units per 500-1000mL solution • Methylergonovine(Methergine) <ul style="list-style-type: none"> ○ 0.2 milligrams IM (may repeat) • 15-methyl PGF2α(Hemabate, Carboprost) <ul style="list-style-type: none"> ○ 250 micrograms IM (may repeat in q15 minutes, maximum 8 doses) • Misoprostol (Cytotec) <ul style="list-style-type: none"> ○ 800-1000 micrograms PR ○ 600 micrograms PO or 800 micrograms PL

	<input type="checkbox"/> Prepare OR, if clinically indicated (optimize visualization/examination)	
<p>Checklist: Stage 2</p> <p>Continued bleeding EBL up to 1500 mL</p> <p>OR</p> <p>>2 uterotonics with normal vital signs and lab values</p>	<p>Initial Steps</p> <ul style="list-style-type: none"> <input type="checkbox"/> Mobilize additional help <input type="checkbox"/> Place 2nd IV (16-18g) <input type="checkbox"/> Draw stat labs (complete blood count, coagulation, fibrinogen) <input type="checkbox"/> Prepare operating room <p>Medications</p> <ul style="list-style-type: none"> <input type="checkbox"/> Continue stage 1 medications <p>Blood Bank</p> <ul style="list-style-type: none"> <input type="checkbox"/> Obtain 2 units red blood cells (do not wait for labs. Transfuse per clinical signs/symptoms) <input type="checkbox"/> Thaw 2 units fresh frozen plasma <p>Action</p> <ul style="list-style-type: none"> <input type="checkbox"/> Escalate therapy with goal of hemostasis <input type="checkbox"/> Huddle and move to Stage 3 if continued blood loss and/or abnormal VS 	
<p>Checklist: Stage 3</p> <p>Continued bleeding with EBL >1500 mL OR>2 units RBCs given</p> <p>OR</p> <p>Patient at risk for occult bleeding or coagulopathy</p> <p>OR</p> <p>Patient with abnormal vital signs/labs/oliguria</p>	<p>Initial Steps</p> <ul style="list-style-type: none"> <input type="checkbox"/> Mobilize additional help <input type="checkbox"/> Move to OR <input type="checkbox"/> Announce clinical status <input type="checkbox"/> (vital signs, cumulative blood loss, etiology) <input type="checkbox"/> Outline & communicate plan <p>Medications</p> <ul style="list-style-type: none"> <input type="checkbox"/> Continue Stage 1 medications <p>Blood Bank</p> <ul style="list-style-type: none"> <input type="checkbox"/> Initiate massive transfusion protocol <input type="checkbox"/> If clinical coagulopathy: add cryoprecipitate, consult for additional agents <p>Action</p> <ul style="list-style-type: none"> <input type="checkbox"/> Achieve hemostasis, interventions based on etiology 	
<p>Checklist: Stage 4</p> <p>Cardiovascular Collapse (massive hemorrhage, profound hypovolemic shock or amniotic fluid embolism)</p>	<p>Initial Steps</p> <ul style="list-style-type: none"> <input type="checkbox"/> Mobilize additional resources <p>Medications</p> <ul style="list-style-type: none"> <input type="checkbox"/> ACLS <p>Blood Bank</p> <ul style="list-style-type: none"> <input type="checkbox"/> Simultaneous aggressive massive transfusion <p>Action</p> <ul style="list-style-type: none"> <input type="checkbox"/> Immediate surgical intervention to ensure hemostasis (hysterectomy) 	

Post-Hemorrhage Management	<ul style="list-style-type: none"> <input type="checkbox"/> Determine disposition of patient (whether ICU required) <input type="checkbox"/> Debrief with the whole obstetric care team <input type="checkbox"/> Debrief with patient and family <input type="checkbox"/> Document information in patient medical record
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Appendix B. American College of Obstetricians and Gynecologists Bundle on Obstetric Hemorrhage: Mass Transfusion Protocol

<p>Blood Bank: Massive Transfusion Protocol</p> <p>In order to provide safe obstetric care institutions must:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Have a functioning Massive Transfusion Protocol (MTP) <input type="checkbox"/> Have a functioning Emergency Release Protocol (a minimum of 4 units of O-negative or uncrossmatched red blood cells)* <input type="checkbox"/> Have the ability to obtain 6 units PRBCs and 4 units FFP (compatible or type specific) for a bleeding patient <input type="checkbox"/> Have a mechanism in place to obtain platelets and additional products in a timely fashion <input type="checkbox"/> Blood transfusion or cross-matching should not be used as a negative quality marker & is warranted for certain obstetric events. <input type="checkbox"/> Hospitals are encouraged to coordinate efforts with their laboratories, blood banks, and quality improvement departments to determine the appropriateness of transfusion and quantity of blood products necessary for these patients. <p>Important protocol items to be determined at each institution are:</p> <ol style="list-style-type: none"> 1. How to activate MTP 2. Blood bank number & location; notify as soon as possible 3. Emergency release protocol that both blood bank staff and ordering parties (MD/RN/CNM) understand 4. How blood will be brought to labor and delivery unit 5. How additional blood products/platelets will be obtained 6. Mechanism for obtaining serial labs, such as with each transfusion pack, to ensure transfusion targets achieved <p><i>I. Patient currently bleeding & at risk for uncontrollable bleeding</i></p> <ol style="list-style-type: none"> 1. Activate MTP –call (add number) and say “activate massive transfusion protocol” 2. Nursing/Anesthesia draw stat labs <ol style="list-style-type: none"> a. Type & crossmatch b. Hemoglobin and platelet count, PT(INR)/PTT, fibrinogen, and ABG (as needed)
--

II. Immediate need for transfusion

(type and crossmatch not yet available)

1. Give 2-4 units O-negative PRBCs
("OB EMERGENCY RELEASE")

III. Anticipate ongoing massive blood needs

OBTAIN MASSIVE TRANSFUSION PACK (consider using coolers); administer as needed in the following ratio 6:4:1)

- 6 units PRBCs
- 4 units FFP
- 1 apheresis pack of platelets

IV. Initial lab results

1. Normal anticipate ongoing bleeding repeat massive transfusion pack bleeding controlled deactivate MTP
2. Abnormal repeat massive transfusion pack repeat labs consider cryoprecipitate and consultation for alternative coagulation agents (Prothrombin Complex Concentrate [PCC], recombinant Factor VIIa, tranexamic acid)

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The AANA Board of Directors adopted "Guidelines for the Management of the Obstetrical Patient for the Certified Registered Nurse Anesthetist" at the 1998 Preconvention Board Meeting. The guidelines became effective January 1, 1999. It was revised by the AANA Board of Directors January 2013.

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