AANA
American Association of
NURSE ANESTHESIOLOGY

Analgesia and Anesthesia for the Obstetric Patient

Practice Guidelines

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Introduction

The American Association of Nurse Anesthesiology (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 and related procedures. In the context of these guidelines, anesthesia is the care provided for surgical intervention (e.g., cesarean delivery), 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 institutional policy, but constitute practice recommendations and considerations to be referenced in the development of 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, guidelines, and scientific literature.

Certified Registered Nurse Anesthetists (CRNAs) provide equitable, compassionate, holistic, patient-centered anesthesia, pain management, and related care encompassing each patient's unique needs and preferences. By acknowledging that maternal health disparities exist, CRNAs help drive change to reduce maternal-related deaths and implement prevention strategies to reduce racial and ethnic disparities in pregnancy-related mortality.[1] The AANA supports the adoption of evidence-based interventions that improve access to care and the quality of care given to patients.

The primary responsibility of the anesthesia professional is to provide quality and equitable care for the parturient receiving analgesia or anesthesia. It is important that CRNAs work with the interprofessional team to provide coordinated care for the parturient, 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, promote safe delivery of care, and abide by the AANA *Standards for Nurse Anesthesia Practice*[2] and AANA *Code of Ethics for the Certified Registered Nurse Anesthetist*[3] in an unbiased manner.[1] 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 opportunities for process improvement, education, and training to improve patient outcomes and safety.

Disclaimer: The AANA and our content experts have no financial interest related to the content of these guidelines. While certain indications for medications may not be explicitly listed on package inserts, the statements made in these guidelines are supported by evidence, noted in the references. When off-label use of a medication is discussed, it will be identified by an asterisk*.

The dosages listed in these guidelines are current as of July 2022 and are intended to serve as a guide to patient care, rather than a one-size-fits all approach. Every patient is unique. Each anesthesia professional is responsible for independently confirming the correct dosage of medication before administration, based on an assessment and evaluation of the patient, the plan of care, the patient's clinical needs, and any relevant facility policies and procedures. The AANA and our content experts are not responsible

for incorrect dosage administration, and each anesthesia professional assumes full responsibility for how this information is used.

Physiologic Changes During Pregnancy

Anatomical and physiologic changes occur during pregnancy to protect and nourish the developing fetus and prepare the parturient for delivery.[4,5] Changes in maternal physiology include, but are not limited to:

- **Anatomic**[5-10]
  - Increased body weight, which may lead to an increase in subcutaneous fat in the lumbar region.
  - Increased chest circumference and breast volume.
  - Epidural venous plexus increases.
  - Spinal cerebrospinal fluid is reduced.
- **Respiratory**[5,7-11]
  - Airway: capillary engorgement, oropharyngeal and glottic edema.
  - Increased minute ventilation and oxygen consumption.
  - Decreased functional residual capacity.
- **Cardiac**[5,7-10,12]
  - Increased circulating volume, resulting in an increase in cardiac output, stroke volume, and heart rate.
- **Vascular**[5,7-10,12]
  - Decreased systemic vascular resistance.
  - Peripheral venous engorgement and stasis.
- **Gastrointestinal**[5,7-10,13-15]
  - Gastroesophageal reflux is common (affecting 40% to 85% of women during pregnancy), and gastric motility decreases significantly in the third trimester of pregnancy.
  - Statistically and clinically significant longer gastric emptying times occur if the parturient receives sedative or opiate drugs.
  - Lower esophageal sphincter tone declines as pregnancy progresses.
- **Hepatic**[5,7-10]
  - Decreased pseudocholinesterase, serum albumin, and gallbladder emptying.
- **Endocrine**[5,7-9]
  - Insulin resistance and relative hypoglycemia.
- **Immunologic**[5,7-9,16,17]
  - Increased leukocytes, resulting in elevated core temperature during pregnancy and labor.
  - Immunosuppressed state, decreasing autoimmune symptoms.
- **Hematologic**[5,7-10,17-19]
  - Increase in plasma volume and red blood cell mass. Increase in plasma volume exceeds increase in red blood cell volume, resulting in a physiologic anemia.
  - Decrease in albumin and alpha-1-acid glycoprotein (AAG).
  - Increased platelet consumption and increased platelet aggregation.
  - Almost all coagulation factors increase, creating a hypercoagulable state, including fibrinogen (factor I).
- **Renal**[5,7-10,20]

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

Pregnancy Preanesthesia Assessment and Evaluation

The AANA's *Documenting Anesthesia Care*[4] recommends assessment and evaluation criteria regarding general health, allergies, medication history, preexisting conditions, and obstetric and anesthesia history in order to develop a patient plan of care for analgesia and anesthesia. Lab work should be ordered on an individual patient basis. Areas specific to the assessment and evaluation of the obstetric patient include:[21-23]

- Current medications, especially those that interact with labor analgesics and anesthetics (e.g., selective serotonin reuptake inhibitors, anticoagulants, antihypertensives, naltrexone/buprenorphine, herbal medications/supplements).
- Current or recent alcohol, stimulant, opioid and/or marijuana use (recreational or prescribed).
- Identification of difficult airway and/or generalized tissue edema.
- Examination of the patient's back for rash, infection, and palpation of bony landmarks.
    - If bony landmarks are not palpable, consider pre-procedural neuraxial ultrasound to identify midline and intervertebral spaces.
    - Scoliosis
        - Evaluate location and angle of curvature.
        - Review prior imaging studies, if available.
        - Document prior back surgery and details, if applicable.
            - E.g., spina bifida (type, date of surgery), laminectomy, Harrington rods.
- Last oral intake prior to admission and history of gastroesophageal reflux disease (GERD) prior to pregnancy.
- Cause of fever greater than 38 degrees Celsius.
- Need for additional diagnostic tests (e.g., preeclampsia, renal impairment, significant cardiovascular disease, autoimmune disease).
- Prior nerve injury or neuropathy.
- Presence of abnormal bleeding or bruising; history of significant bleeding event.[24]
- History of migraine headaches.
- Fetal status and progress of labor.

Parturients whose anesthesia and analgesia may be challenging or are known to be at risk of significant morbidity should be evaluated prior to labor in collaboration with the interprofessional team.[25,26] Examples of patient conditions that may pose an increased risk for analgesia and anesthesia include, but are not limited to:[27]

- Morbid obesity, BMI greater than 40.
- Hypertension, chronic and new onset.
- Thrombocytopenia, anti-clotting therapy (i.e., antiplatelet, anticoagulant).
- Spinal fusion, spine surgery, or musculoskeletal defect (e.g., scoliosis).
- Recent or previous back injury without surgery.
- Chronic pain.
- Substance use disorder.
- Active COVID-19 and/or its variants.

- 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 [MH]).
- Cardiac (e.g., cardiomyopathy, congenital/acquired disorders, presence of implanted pacemaker).
- Neurologic (e.g., seizure disorder, para/quadriplegia, increased intracranial pressure, intracranial lesion).
- Difficulty or complication with previous epidural or spinal.

Patient Education, Plan of Anesthesia Care, and Informed Consent

The anesthesia professional, in partnership with the interprofessional healthcare team, develops the plan of anesthesia care with the parturient as an engaged, informed, and active decision-maker. The informed consent process provides an opportunity for the anesthesia professional and the parturient to share information, define expectations, and explore the parturient's needs, preferences, previous experiences, and concerns to develop the patient plan of care.[28-30] The AANA's *Informed Consent for Anesthesia Care*[31] provides additional details regarding the elements of informed consent, including special considerations for parturients. These considerations include antenatal education about possible analgesia and anesthesia so that the parturient has realistic expectations. Brochures or online videos may help the parturient fully understand options, but they should not replace meaningful discussion. Specific risks that should be disclosed include those with high incidence, high morbidity, or adverse fetal effects.

It is ideal to discuss options for analgesia and anesthesia as early as possible in a patient-centered way while managing expectations of the parturient's requested birth plan.[30,32,33] A parturient may not be willing to sign an anesthesia consent on admission. The parturient may express a desire to have an unmedicated delivery but may express a different decision as labor progresses.[34] With the parturient's consent, conduct discussions when the patient's family or other support persons are present in compliance with the parturient's wishes and applicable healthcare privacy laws. The informed consent discussion, including anesthesia and analgesia options and associated risks, should be well documented.[30,35,36]

Consider parturient and family demographics, sociocultural factors, and health beliefs during the informed consent process. When communicating with the parturient, considerations include, but are not limited to, health literacy, socioeconomic status, family structure, disease history, religion, immigration status, and decision-making styles (e.g., familial, individual, delegated, deferential). Modify the vocabulary, tone, and pace of the discussion to meet the parturient's level of understanding. Verify that the parturient understands the information that has been shared. Family members should not act as medical translators. Access available institutional resources, such as translation and language assistance services, to provide information in the parturient's spoken or visual language in compliance with applicable law.[30,37] If a family refuses translation service, abide by institutional policy.

As appropriate for the parturient and the situation, informed consent should consist of a discussion and description of the proposed analgesic and anesthetic intervention (e.g., epidural, combined spinal epidural, spinal, dural puncture epidural, general anesthesia), the benefits, common side effects, potential risks, possible complications, and appropriate alternative options to the procedure. Any questions should be answered during the discussion that includes but is not limited to:[30,38]

- Goals for intrapartum care, postanesthesia care and recovery.[29]

- Pharmacologic and non-pharmacologic labor and delivery analgesia and anesthesia considerations for each phase of labor and delivery, including special emergent or emergency circumstances.
- Possibility of delay in labor analgesia due to another parturient's 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.[33]

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; 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.[39,40] 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 parturient status permits, discuss what the parturient will experience and answer any questions they and/or their support person may have.[30,36]

When a maternal or fetal emergency occurs and a transfer of care is required, parturient history is quickly acquired during the handoff as emergent care is simultaneously provided. If immediate treatment or intervention is warranted because the parturient 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.[41] When the parturient 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.[30,34,41] An advance directive executed by the parturient may identify the legal decision maker or specify the parturient's wishes.[41]

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.[42] 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, or guardians, that the minor is receiving services if the provider deems it in the minor's best interests. Institutional policy should include state-specific law regarding the legal ability of a pregnant minor to consent to obstetric analgesia and anesthesia. For more information on minors, emancipated minors and mature minors, review the AANA *Informed Consent for Anesthesia Care*[31] and the American College of Obstetricians and Gynecologists (ACOG) Committee Opinion Confidentiality in Adolescent Health Care.[31,43]

Maternal-Fetal Conflict

Although rare, there are situations in which a parturient may refuse consent for anesthesia (e.g., refusal for an emergency cesarean delivery) that may jeopardize their and their fetus's health or

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life. In these situations, an anesthesia professional may be caught in an ethical conflict between the principles of beneficence (promoting parturient well-being and doing no harm) and respect for the parturient's autonomy.[30,33] While some court decisions have ruled to protect fetal rights, others have ruled in favor of the parturient's autonomy.[33] When such conflicts arise, the anesthesia professional should respectfully continue to dialogue with the parturient in a non-coercive manner and be available should the parturient modify their decision.[30,33] 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.[30,33] An ethics consultation may provide helpful information to address maternal-fetal conflicts.[44] The anesthesia professional should carefully document the informed consent process and the reasons for the parturient's refusal of anesthesia services.[30,45]

Anesthesia for Procedures during Pregnancy

Procedures that require anesthesia may occur during pregnancy but should be avoided until after delivery when possible.[10] Anesthesia during pregnancy balances the optimal care and safety of both the parturient and the fetus.[10] Anesthetic agents have the potential to be teratogenic to the fetus; therefore, unnecessary exposure to agents should be avoided when possible.[7,10,46] If there are no or minimal increased risks for the parturient, consider delaying essential procedures requiring anesthesia until the second trimester to avoid teratogenic effects.[47,48] If there is a need for emergency surgery, consult with an obstetric professional prior to the surgery. It is recommended that benzodiazepines are only used in pregnancy if the benefit to the parturient outweighs the risk to the fetus.[49,50]

Considerations for anesthesia during pregnancy include:[10,48,51-53]

- Neuraxial is preferred to general anesthesia, when possible.
- Maintain normal maternal physiology.
- Avoid aortocaval compression with lateral or knee to chest positioning if necessary.
- Optimize uteroplacental perfusion by maintaining cardiac output and avoiding maternal hypotension and hypoxia.
- Consider limiting use of nitrous oxide in parturients receiving inhalational anesthesia during the first trimester.
- Monitor fetal status.
    - The decision to use fetal monitoring should be individualized, based on parameters such as gestational age, type of surgery, facilities, equipment, and qualified staff available.
    - If the fetus is considered viable, it is generally sufficient to ascertain the fetal heart rate (FHR) before and after surgery.
    - Monitor maternal contractions after procedure for viable fetus.

Analgesia and Anesthesia for Labor and Delivery

Choice of pain relief should be based on parturient condition, provider skill set, the resources available at the practice setting, and the parturient's desires and consent. Analgesia and anesthesia considerations are unique for each parturient 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.[25,54] A multimodal plan for labor and, when necessary, surgical anesthesia and analgesia, limits the use of opioids through a patient plan of care that integrates non-pharmacologic, parental opioid,

non-opioid, neuraxial and surgical field block.[54] Refer to institutional policy for guidance regarding family member presence during analgesia and anesthesia procedures.

Infection Prevention and Control for Obstetric Care

Adherence to infection prevention and control practices are important for parturient, family, and healthcare professional safety. These practices include hand hygiene, personal protective equipment, safe injection practices, sterile technique, and proper skin preparation. Chlorhexidine gluconate is the preferred skin prep agent due to immediate action, residual activity, and persistent effectiveness against a wide range of microorganisms.[55-61] The AANA *Infection Prevention and Control Guidelines for Anesthesia Care*[59] and AANA *Safe Injection Guidelines for Needle and Syringe Use*[62] offer guidance on infection prevention and control practices. See preventions to prevent surgical site infections under **General Anesthesia.**

Staff and Resource Availability

Institutional leadership and the departments of obstetrics, nursing, and anesthesia should collaboratively develop evidence-based policies and procedures regarding staffing and on-call availability. The policies and procedures should consider staffing variations in the design and size of obstetric units; demands of particular surgical, diagnostic, or therapeutic procedures; parturient and provider safety; and anticipated needs of the parturient and fetus.[63] 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 institutional policy. The AANA supports evidence-based collaborative levels of care which utilize CRNAs to provide services to their full scope of practice, education, and training without unnecessary barriers, which results in costly duplication of services and inefficient use of limited resources. AANA encourages facilities to foster a collaborative/consultative care delivery model, which can optimize the value and efficiency of anesthesia services.[64] CRNAs are encouraged to verify any applicable state law and regulations regarding maternal care staffing and resource availability.

Routine and emergency equipment, drugs, supplies, and other resources should be available in the area where analgesia and anesthesia are performed.[23,63,65-68] 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[23,25,66-70]

Drug	Equipment	Monitor
• Albumin • Antihypertensives (e.g., labetalol, hydralazine) • Atropine • Calcium chloride • Dexamethasone • Epinephrine • Glycopyrrolate • Hypnotic-amnestic agents (e.g., propofol, ketamine) • Inhalation agents¥ • IV fluids • Ketorolac	• Extra oxygen cylinder • Nasal cannulas plain and with $ETCO_2$ sampling port • Suction with tubing with Yankaur and suction catheters • Self-inflating bag and mask for positive-pressure ventilation • Breathing circuit filters appropriate for patients at risk or positive for COVID-19 and/or its variants • Face masks • Non-rebreathing masks	• Electrocardiogram • Noninvasive blood pressure monitor • Transducer for invasive blood pressure monitoring • Pulse oximetry • Capnography • Oxygen and volatile agent analyzers • Qualitative carbon dioxide detector

• Local anesthetics • Metoclopramide • Naloxone • Ondansetron • Rocuronium • Sodium bicarbonate • Succinylcholine¥ • Tranexamic Acid • Uterotonic medications (e.g., oxytocin, methylergonovine maleate, carboprost tromethamine) • Vasopressors (e.g., phenylephrine, ephedrine)	• Oral airways • Laryngoscope • Endotracheal tubes with stylet • Eschmann stylet • Peripheral nerve stimulator • Infusion pump and tubing for at least two medications • Flashlight • Ventilator • Patient warming/cooling device • Carbon breathing circuit filters	

Volume Resuscitation	Difficult Airway Considerations
• Large-bore peripheral and central catheters • Fluid warmer • Pressure bags • Blood products • Blood filters • Rapid infuser	• Video laryngoscope • 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[71] for recommendations*¥

Non-pharmacologic Analgesia
The parturient may select non-pharmacologic pain management modalities alone or with pharmacologic modalities for labor, delivery, and postpartum analgesia. Non–pharmacologic techniques include natural childbirth, guided imagery, hydrotherapy, transcutaneous electrical nerve stimulation, acupuncture, hypnosis, and doula emotional support.[54,72] Anesthesia professionals should support and integrate the patient's choice for non-pharmacologic analgesia into pain management considerations within the patient's plan of care

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 and may have adverse effects such as nausea and vomiting and/or placental transfer to the fetus.[25] Patients with conditions such as hepatic and renal diseases, morbid obesity, and sleep apnea are more susceptible to opioid respiratory depressant effects.[73] Consider a reduced dose or elimination of opioids with these comorbidities.

Oxytocin Management
First stage of labor[74]

Oxytocin may be given to induce or augment labor. The goal is to increase uterine activity to dilate the cervix without causing fetal compromise due to uterine tachysystole. Recommended doses of oxytocin range from 1 to 6 mU/min.

Third stage of labor

Active management of the third stage of labor includes the recommendation of prophylactically administering oxytocin.[75] This has been found to reduce the incidence of, and be a prophylactic treatment for, postpartum hemorrhage, as uterine atony accounts for 70% to 80% of postpartum hemorrhage cases.[75,76] See **Postpartum Hemorrhage** for more details on prevention and treatment.

Large and rapidly administered oxytocin boluses should be avoided to minimize side effects. These include flushing, nausea and vomiting, tachycardia, hypotension, delayed water retention, hyponatremia, and seizures.[77,78] It is recommended that an established evidence-based protocol, such as the Rule of Threes, or an IV infusion regimen your institution warrants as appropriate, is standardized and utilized.[79,80] These techniques are described below in Table 2.

Recommendations include administering oxytocin in pre-mixed intravenous (IV) bags by maintenance infusion, per institutional policy.[81] If providing oxytocin via IV is unavailable, it is recommended that the maternal patient receives an intramuscular injection of 10 units.[75] In the event that oxytocin is unavailable, see ACOG's FAQ on recommendations.

Table 2. Oxytocin administration protocol examples

Rule of Threes[78,79,82]	IV Infusion Regimen[77]

• 1st bolus dose, administered to all maternal patients
  ○ On cord clamp, administer 3 units IV oxytocin over 30 to 45 seconds. It is suggested to mix the 3 units in a 10 mL syringe for easier administration.
  ○ 3 minutes following the 1st bolus dose, ask the obstetric provider to assess uterine tone.
  ▪ If uterine tone is adequate, no further interventions are required.
  ▪ If uterine tone is inadequate, administer 2nd dose of oxytocin 3 units IV, or another uterotonic agent per the direction of the obstetric provider.
  ○ 3 minutes following the 2nd bolus dose, ask the obstetric provider to assess uterine tone.
  ▪ If uterine tone is adequate, no further interventions are required.
  ▪ If uterine tone is inadequate, administer 3rd dose of oxytocin 3 units IV, or another uterotonic agent per the direction of the obstetric provider.
	Elective Cesarean Delivery
	• Bolus 1 IU oxytocin; start oxytocin infusion at 2.5-7.5 IU/hr (0.04-0.125 IU/min)
	
	Intrapartum Cesarean Delivery
	• 3 IU oxytocin over ≥30 sec; start oxytocin infusion at 7.5-15 IU/hr (0.125-0.25 IU/min)

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○ If uterine atony continues after three total doses of oxytocin, other uterotonics should be administered. • Initiate a constant infusion of 3 units per hour for up to five hours.	

Inhalation Analgesia
Nitrous oxide combined with oxygen provides rapid onset pain relief (approximately 30 to 50 seconds), making it an option for managing pain in labor, though not a substitute for neuraxial analgesia.[83-86] Approximately 40% to 60% of parturients who begin with nitrous oxide will transition to using neuraxial analgesia.[85,86] Patients may self-administer 50% nitrous oxide via a blender device.[53,84,86] An apparatus that limits concentration of nitrous oxide should be utilized and inspected periodically for accurate delivery concentrations. Common side effects of nitrous oxide include nausea (45%) and vomiting, drowsiness, and dizziness (23%).[84-86] Nitrous oxide produces minimal cardiovascular and ventilation changes, and can reduce tidal volume; however, respiratory rate increases to compensate.[86] The occasional oxygenation desaturation may be due to hyperventilation associated with hypocapnia rather than diffusion hypoxemia.[86] Parturient and fetus should be monitored according to institutional policy, and waste gas scavengers should be utilized.[53,84-87]

Neuraxial Analgesia and Anesthesia for Labor and Delivery
Neuraxial technique(s) may be used to manage pain effectively and safely during labor and/or facilitate anesthesia for an operative delivery.[88] With adequate time and rapid-acting local anesthetics, a labor epidural may be converted to a surgical anesthetic. Use of neuraxial anesthesia for delivery may cause fewer maternal complications and adverse neonatal outcomes than those associated with general anesthesia.[66,78,88,89]

The neuraxial technique provides adequate pain relief and/or sensory blockade while preserving motor function, typically achieved by administering a combination of low concentration local anesthetics (defined as 0.0625% to 0.125% bupivacaine or 0.08% to 0.2% ropivacaine) with or without low dose opioids, which allows for lower doses of each agent and mitigates adverse side effects and shortens latency.[23,53,66,90-93] 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.[66]

A forceps delivery requires stronger analgesia at a slightly higher level than a vacuum-assisted delivery, and the perineum needs to be more relaxed. The analgesic goal is for the parturient to feel the pressure of a contraction and still be able to push. If the parturient needs a laceration repair, administer a surgical dose of a short-acting local anesthetic (e.g., chloroprocaine, lidocaine) unless the obstetric provider infiltrates locally.[66]

Neuraxial Contraindications
Neuraxial analgesia and anesthesia are contraindicated in the following situations:[25,66,94-96]
- 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.

- Severe aortic stenosis (general anesthesia may be preferred for cesarean delivery).

Clotting Status

Parturients receiving anticoagulation therapy (e.g., antiplatelet, anticoagulant) or with platelet dysfunction are at increased risk of developing an epidural/spinal hematoma.[24,89] Order and review the following coagulation tests based on a parturient's medical history, physical examination, pharmacologic therapy, and clinical signs (e.g., preeclampsia):[89,97-99]

- Platelet count.
- Prothrombin time.
- International normalized ratio.
- Activated partial thromboplastin time.
- Activated clotting time.
- Viscoelastic testing - Thromboelastography (TEG) or ROTEM® delta analysis, if available.

A platelet count of 70,000 x 10^6/L or higher likely has a low risk of spinal epidural hematoma; upon discussion between the parturient, obstetric professional, and the anesthesia professional, the parturient may undergo a neuraxial procedure.[24,88] When the parturient platelet count is between 50,000 and 70,000 x 10^6/L, weigh the risks and benefits with the parturient and obstetric professional to develop the plan for analgesia and anesthesia based on the parturient's overall clinical condition, including coagulation status.[100] ACOG recommends platelet transfusion in preeclampsia for active bleeding or to improve the platelet count to 50,000 × 10^6/L before cesarean delivery.[101]

- Recommendations to determine the time interval between last dose of anticoagulation therapy and spinal or epidural placement and catheter removal can be found in institutional policy and/or the *American Society of Regional Anesthesia and Pain Medicine*.
- Avoid insertion and removal of catheter in the presence of coagulopathy.[102]

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.[23,103-105] Parturients may be treated with neuraxial opioids, local anesthetics, or a combination of these drugs as labor progresses.[88,106]

Neuraxial techniques can be used during labor, vaginal delivery, or cesarean delivery, although agents and dosing will vary. Administration of neuraxial analgesia for patients with comorbidities (e.g., preeclampsia, hypertension, morbid obesity) in early active labor can help control maternal blood pressure, attenuate hypertensive response to pain, improve placental blood flow, and prepare for emergent delivery (e.g., parturients undergoing trial of labor after cesarean). Frequent assessment of the parturient's comfort and labor status provides the anesthesia professional with information necessary to optimize analgesia, parturient 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 3.

Table 3. Description of neuraxial techniques

Method	Description and Considerations
Neuraxial Anesthesia[53,59,66,88]	• Perform a preprocedure evaluation. Obtain informed consent after explanation of the procedure, review of the side effects and/or potential complications, and discussion concerning the goals of neuraxial analgesia/anesthesia to establish expectations. (See **Patient Education, Plan of Anesthesia Care, and Informed Consent** above.) • Perform a "timeout" with patient and obstetric nursing personnel. • Sterile preparation and draping of patient's back. • Monitor maternal pulse oximetry, blood pressure and fetal heartrate post neuraxial technique, per institutional policy. • After establishment of neuraxial analgesia, assess sensory level and maternal pain score per institutional policy.
Epidural[53,66,88]	Intermittent and continuous administration of local anesthetics and/or opioids through an epidural catheter: • Use 2 to 4 mL of saline, air, or saline with a small air bubble, to determine loss of resistance. Injection of air into the epidural space may contribute to a patchy anesthetic and/or pneumocephalus.[107-109] • Ensure the epidural needle is cephalad prior to placing the catheter and thread the catheter 3 to 6 cm. The risk for unilateral block is greater when the catheter is inserted 6 to 8 cm.[107] • Administer institutional or departmental agreed upon epidural catheter test dose (See **Epidural Catheter Test Dose** below).
Single Shot Spinal (Intrathecal Injection)[66,88,107]	• Consider for patients who require analgesia shortly before anticipated vaginal delivery, and for surgical indications. • Use pencil-tip, 25- to 27-gauge spinal needle with introducer needle.
Combined Spinal-Epidural (CSE)[23,53,88,107,110]	• Consider for patients who require immediate analgesia for an anticipated vaginal delivery, and/or for extended surgical indications. • Proceed with epidural technique as described above. • Once epidural space is identified, pass a 5 inch 25- to 27-gauge spinal needle through the epidural needle to the subarachnoid space. • Once spinal fluid is visualized, carefully attach the syringe, and inject the intrathecal dose slowly. • Remove the spinal needle and thread the catheter at least 3 cm but not more than 6 cm. • Once the catheter is secured, administer an epidural catheter test dose following institutional policies. • Follow institutional policy for maintenance of epidural infusion rate.

Dural Puncture Epidural (DPE)[53,88,107,111-113]	• DPE is a modification of a combined spinal-epidural technique. • Proceed with CSE technique as described above, utilizing a 5 inch 25-gauge spinal needle. • Once dural perforation is created via spinal needle, do not administer intrathecal medication and proceed with the epidural procedure as above. • DPE technique provides improved analgesia and sacral spread, reduction in epidural top-ups.

Neuraxial Insertion Preparation

Prepare the patient for neuraxial analgesia and anesthesia by positioning them into a lateral or sitting position.[114,115] Preparing the patient's skin prior to performing neuraxial techniques significantly reduces the risk of infection. Follow manufacturer recommendations and institutional policy for the proper use of skin prep agents, including dry times. 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.[116,117] Each agent has a specific mechanism of action along with specific advantages and disadvantages that should be weighed in all clinical situations.[116] 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.[55-61,116] 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.[118]

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.[53,119-121] Ultrasound guidance facilitates neuraxial anesthesia placement, improves first pass success rate in patients with anticipated puncture difficulty, as well as decreases needle redirections and punctures, risk of vascular punctures and incidence of backache.[53,88,119-121]

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.[119,121]

Circulating Volume

Insert and maintain venous access and intravenous infusion to administer medication; maintain circulating volume and hemodynamic status. Crystalloid solution may be administered (preload or co-load) to limit hypotension during neuraxial analgesia/anesthesia.[23,122-124] 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.[71,124] Hypotension should be treated with appropriate doses of vasopressors.[77,78,123]

Epidural Catheter Test Dose

An epidural test dose of local anesthetic, with or without epinephrine, is a method to help identify an unintentional epidural catheter placement in a vein or the subarachnoid space.[38,125] A common mixture for test dose is 3 mL of 1.5% lidocaine with epinephrine 1:200,000.[38,107] Prior to administering a test dose, the epidural catheter should be gently aspirated while observing for the presence of blood or cerebral spinal fluid (CSF) in the catheter. A test dose should be administered in between contractions. If blood is not aspirated through the catheter, a positive intravascular test dose is indicated by an increase of 20 beats per minute within 45 seconds of the dose if epinephrine is used.[107,126] Subarachnoid placement is indicated by continuous aspiration of clear CSF and/or rapid onset sensory and motor blockade.[107] Potential adverse effects of the test dose may include heart palpitations, tachycardia, tachydysrhythmias, hypotension, motor blockade, and, in rare cases, seizures.[125] The epidural catheter is aspirated gently prior to administration of medication to verify the absence of blood or cerebrospinal fluid.[107]

Initiation of Labor Analgesia

Initiate analgesia with incremental doses of 3 to 5 mL bolus doses, 3 to 5 minutes apart, of low concentration local anesthetic (defined as 0.0625% to 0.125% bupivacaine or 0.08% to 0.2% ropivacaine).[23,53,66,90-93] Opioids may be added to the local anesthetic (e.g., fentanyl 50 to 100 µg total or sufentanil 5 to 10 µg total).[66,127]

Epidural Maintenance Infusions

Maintain epidural analgesia with low concentration local anesthetic (defined as 0.0625% to 0.125% bupivacaine or 0.08% to 0.2% ropivacaine) with intermittent bolus injection, continuous epidural infusion (CEI), a continuous infusion with patient-controlled analgesia (PCEA) or a programmed intermittent epidural bolus (PIEB) according to institutional policies.[23,53,66,90-93]

CEI

Continuous epidural infusion delivers a constant rate of a low concentration local anesthetic with or without opioids. This method of analgesia maintenance is effective; however, it places the maternal patient at risk for motor block and weakened pelvic muscle tone that may make the second stage of labor more difficult (i.e., instrumented delivery).[66,92]

PCEA

Local anesthetic solutions used for PCEA are the same as CEI. Studies suggest larger bolus volumes be utilized if a background infusion is not administered with the PCEA method. The safety of large-volumes boluses exceeding 10 mL has not been determined.[66]

The following steps should be taken to ensure safe PCEA with opioids:[66,88,128,129]

- 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).
    - 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 institutional policy.
    - Continuous use of pulse oximetry to monitor oxygenation and technology to monitor respiration (e.g., capnography, acoustic monitoring) according to institutional policy.

- In patients with risk factors for respiratory depression (e.g., obesity, asthma, sleep apnea or medication therapy that may potentiate opioids), consider continuous capnography monitoring.

- Inform patients and staff of concerns regarding PCEA by proxy
  - Teach staff, patients, and family members the correct use of PCEA 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.*"

PIEB

Programmed intermittent epidural bolus provides a predetermined local anesthetic solution bolus at programmed time intervals.[53,66,130] A bolus dose is administered at a high pressure which distributes more widely compared to CEI.[66,130] PIEB enhances maternal satisfaction, shortens labor duration, decreases motor block, and reduces local anesthetic consumption.[53,66,130]

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 FHR.[2,66] High-risk patients may also require electrocardiogram and arterial blood pressure monitoring.[129] Refer to institutional policy for monitoring recommendations for patients receiving obstetric analgesia and anesthesia. Refer to AANA *Care of Patients Receiving Analgesia by Catheter Techniques*[110] for guidance on monitoring patients receiving analgesia through various catheter techniques.

General Anesthesia

General anesthesia may be necessary for a cesarean delivery or other obstetric surgical emergencies. Indications for general anesthesia include, but are not limited to, inability to place neuraxial anesthesia, inadequate neuraxial anesthesia, patient refusal of neuraxial anesthesia, or request for uterine relaxation (cesarean delivery with an ex-utero intrapartum treatment procedure).[78]

General anesthesia for obstetric patients is outlined below:

1. Provide prophylaxis for gastric aspiration. This may include non-particulate antacid orally, serotonin antagonists, proton pump inhibitors, metoclopramide, or other agents alone or in various combinations, given with appropriate lead time for full effect prior to induction.[78]
2. Take precautions to prevent surgical site infections:[78,131-134]
   a. Administer first generation cephalosporin within 60 minutes before skin incision dosed according to maternal weight.
      i. Cefazolin 2 g IV if < 120 kg; 3 g IV if ≥ 120 kg
      ii. First generation cephalosporins should be re-dosed when a surgical procedure lasts four hours or more or when blood loss is greater than 1500 mL.
   b. Patients with anaphylaxis to penicillin may receive a combination of clindamycin and gentamycin or vancomycin alone.
      i. Clindamycin 900 mg IV and gentamycin 5 mg/kg
      ii. Vancomycin should be administered within a 2-hour period before the anticipated incision as it needs to be administered over an hour.

   c. If the membranes are ruptured, administer 500 mg azithromycin in addition to broaden protection.
   d. Maintain normothermia. The use of forced air warmers and increased operating room temperature have shown to decrease rates of perioperative hypothermia in parturients.[77]
   e. Follow institutional policies for management of blood sugar in diabetic patients.
3. Maintain left uterine displacement.[78,135]
4. Airway management:[78,136,137]
   a. Preoxygenate the patient with 100% oxygen during skin prep and placement of monitors; once the abdomen is prepped and draped, and surgical team is ready for incision, conduct a rapid sequence induction with cricoid pressure.
   b. Consider use of video laryngoscopy to provide optimal view for successful first attempt intubation with a small diameter cuffed endotracheal tube (e.g., 6.5 or 7 mm).
   c. Once endotracheal tube placement is confirmed, inform the obstetrician the procedure may begin.
5. Maintenance of anesthesia:[78]
   a. Provide approximately 1 MAC of halogenated agent between intubation and delivery; then reduce the concentration to 0.5 to 0.75 MAC after delivery to minimize uterine relaxation.
   b. Administer muscle relaxant, if indicated, and ensure adequate muscle relaxant reversal before extubation.
6. After delivery of the neonate:[75,78]
   a. Administer bolus and/or continuous infusion of oxytocin, avoiding large boluses or rapid infusions; consider other uterotonic agents as directed by the obstetrician. See **Oxytocin Management** and *Appendix B. ACOG District II Safe Motherhood Initiative Maternal Safety Bundle for Obstetric Hemorrhage: Hemorrhage Checklist* for additional details.
   b. Administer post-cesarean analgesia and anti-emetics as described below.

Post-Cesarean Analgesia

Multimodal postoperative pain management, as an element of enhanced recovery after surgery (ERAS), is important for the immediate and long-term success of patients undergoing cesarean deliveries. Appropriately managed postoperative pain optimizes the mother's ability to be mobile, care for her neonate and breastfeed.[138-140] Acute pain may increase the risk of post-partum depression, thromboembolic event, and chronic pain development with potential persistent opioid management.[139-144]

Studies suggest neuraxial blockade may prevent central sensitization and chronic pain development.[73,139] Multiple studies have demonstrated that neuraxial opioids administered as part of the surgical anesthetic provide superior postoperative analgesia when compared with intravenous opioids.[**140**] Intravenous opioids may be administered if an opioid was not added to the neuraxial technique or if breakthrough pain occurs with a neuraxial technique.[139]

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.[142,145,146] A combination of the minimum effective dose of opioid or no opioid, in combination with a non-steroidal anti-inflammatory drug (NSAID),

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acetaminophen, and dexamethasone provides optimal pain relief.[147,148] 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.[140] Dexamethasone and, if indicated, IV acetaminophen administration should occur after cord clamp as per institutional policy.[149,150]

Individualize the multi-modal pain management plan based on overall patient condition.[139] For example, a patient with a history of long-term opioid use, or substance use disorder, may benefit from the addition of a nerve block, local anesthetic wound infiltration, ketamine, and/or gabapentin.[140,149,151,152] Nerve blocks including transversus abdominis plane block (TAP) and quadratus lumborum block (QLB) improve post-cesarean delivery pain control in parturients not receiving neuraxial morphine.[77,139,140] The administration of TAP or QLB blocks to parturients receiving neuraxial morphine has not shown significant analgesic benefit.[77,139,140] A sub-anesthetic intravenous dose of ketamine following cesarean delivery may improve analgesia but does not significantly reduce the risk of persistent post-surgical pain.[153] Additional oral or IV opioids should be reserved for severe breakthrough pain.[77,154]

Implementing ERAS protocols can improve recovery time. AANA *Enhanced Recovery After Surgery*[155] discusses development and implementation of these protocols in more depth.[149,151,152] Refer to ACOG's perioperative pathways on ERAS for more information as well.[156] Table 4 provides an exemplar of multimodal pain management considerations, which should be tailored to be individualized to each patient.

Table 4. Exemplar multimodal pain management therapy considerations

Drug Class	Agent	Route	Dose	Frequency/ Duration of Effect	Considerations
Neuraxial Opioids	Morphine[77,148,157]	Neuraxial	0.5-0.15 mg (intrathecal) 1.0-3.0 mg (epidural)	1x/ 14-36 hours duration	
	Fentanyl*[38,77,127]	Neuraxial	10-25 µg (spinal) 50-100 µg (epidural)	1x / 2-3 hours duration	
	Hydromorphone*[78,127,158-162]	Neuraxial	75-100 µg (spinal)	1x/ 6-24 hours duration	Utilize if morphine is contraindicated or unavailable, per institutional approval
NSAIDs	Ketorolac[73,77,160]	IV	15-30 mg	1x after peritoneum is closed	

Drug Class	Agent	Route	Dose	Frequency/ Duration of Effect	Considerations
	Ibuprofen[77,163]	PO	600-800 mg	q6-8 hours scheduled	Administer 2-3 days via fixed schedule Not to exceed 2400 mg daily
Central Acting Analgesic	Acetaminophen[7,164,165]	IV	1000 mg (not to exceed 3250 mg/day)	q8 hours	Administer IV after delivery Discontinue once oral acetaminophen can be taken
	Acetaminophen[7,164,165]	PO	650-1000 mg not to exceed 3250 mg/day	q6-8 hours scheduled	
Corticosteroid	Dexamethasone[166]	IV	8 mg	1x/ 24 hours	Administer either pre-operatively or after delivery per institutional policy
Considerations for substance use disorder, chronic pain, and/or omission of neuraxial opioids					
***N*-methyl-D-asparate**	Ketamine[149,150]	IV	10 mg or 0.15 mg/kg	1x pre-operative/24 hours duration	Administer after neuraxial anesthesia placed, but prior to surgery start if neuraxial anesthesia insufficient
Local Anesthetic	Bupivacaine; Ropivacaine[149,150]	Truncal Blocks	0.25%-0.375% Bupivacaine (not to exceed 2.5mg/kg)	1x/12 hours duration	Careful not to exceed toxic doses in smaller patients

Drug Class	Agent	Route	Dose	Frequency/ Duration of Effect	Considerations
			0.375%-0.5% Ropivacaine (not to exceed 3mg/kg)		

Removal of Retained Placenta

If the placenta is not delivered within 30 minutes of birth, manual removal may be necessary.[167,168] The administration of oxytocin and clamping and cutting the umbilical cord promptly after delivery may contribute to retained placenta.[168] Analgesia and anesthesia for removal is dependent on patient hemodynamic status and rate of blood loss.[168] Collaborating with the obstetric professional, small doses of intravenous nitroglycerin (e.g., 50 to 100 µg given incrementally with a maximum of 500 µg total) and analgesics may facilitate manual extraction of retained placenta.[167,168] Epidural or spinal anesthesia may be considered for patients who are hemodynamically stable.[167,168] General anesthesia may be necessary if blood loss cannot be controlled and can facilitate manual extraction of retained placenta.[168]

Postpartum 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.[39,169] Take steps to prevent aspiration pneumonitis, detailed in the side effects section below.[169] The anticipated length of the procedure will guide the selection of local anesthetic. Table 5 describes various technique considerations for tubal sterilization.

Table 5. Tubal sterilization techniques[39,137,169]

Spinal	• Small-gauge, non-cutting, pencil point needle (25-27 gauge). • Assess for bilateral T-4 sensory level.
Epidural	• Verify proper placement of the epidural and test dose the catheter. • Assess for bilateral T-4 sensory level.
General Anesthesia	• Administer sodium citrate. • Consider administration famotidine and metoclopramide • Rapid sequence induction with cricoid pressure and video laryngoscopy.

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[66]

- Assess progress of labor and rule out other causes of pain (e.g., fetal malpresentation, full bladder, placental abruption, uterine rupture).
- Evaluate catheter site to ensure it is at the original depth after insertion, not dislodged and/or disconnected.
- Reassess sensory level, maternal pain, and maternal and fetal hemodynamics after each intervention described below.

If the extent of neuraxial analgesia is inadequate but symmetrical:[66,90,91]

- Consider injection of a large volume (e.g., 5 to 15 mL) of low concentration local anesthetic (defined as 0.0625% to 0.125% bupivacaine or 0.08% to 0.2% ropivacaine) with or without low dose opioids in 5 mL boluses and increase the epidural infusion rate.[23,53,66,90-93]
- If the above is not successful, consider injection of additional volume (e.g., 5 to 15 mL) of a slightly higher concentration of bupivacaine or ropivacaine with or without an opioid.
- If this intervention is successful, consider increasing the concentration of the infusion.
- If interventions are unsuccessful, replace the catheter.

If the extent of neuraxial analgesia is inadequate and is asymmetrical:[66]

- Place the less-blocked side in the dependent position.
- Inspect catheter site and withdraw catheter 1 cm, with the goal of having the catheter 3 cm but not more than 6 cm in the epidural space in the epidural space and re-secure the catheter.
- Follow the dosing guidance explained in "*If the extent of neuraxial analgesia is inadequate but symmetrical."*

Hypotension

There is no single intervention that prevents hypotension during labor analgesia or cesarean delivery; however, there are multiple interventions that demonstrate some evidence of effectiveness.[78,170] One should anticipate the most common causes (epidural or spinal-induced hypotension) and prepare accordingly but also continuously assess for potential causes such as aortocaval compression, high block, and/or bleeding.[124] Nausea is frequently the precedent of hypotension.[124]

- It is recommended that the IV fluid bolus is administered as a co-load as opposed to a pre-load.[78,170]
- Administer vasopressors. Phenylephrine 50 to 100 µg IV bolus is the recommended vasopressor unless contraindicated. Prophylactic administration of phenylephrine infusion at 25 to 50 µg/minute has also been recognized as a preventative measure to avoid spinal-induced hypotension.[78,123,124,170,171]
- Consider administering 4 mg of ondansetron to prevent hypotension and associated complications during cesarean delivery.[170,172]
- Consider additional positional changes for significant spinal-induced hypotension.[78]

Pruritus

Opioid-induced pruritus may be generalized or localized in regions and is dependent on the dose of opioid given; therefore, use the lowest effective dose.[66] Treat pruritus with pharmacologic treatments such as opioid agonist/antagonist (e.g., nalbuphine 2.5 to 5 mg IV bolus) and opioid antagonists (e.g., naloxone 40 to 80 µg IV bolus/ 1 to 2 µg/kg/hour continuous infusion, 6 mg oral naltrexone).[66,173]

Nausea and Vomiting

Nausea and vomiting can increase the chance of aspiration, as well as decrease patient satisfaction and increase the length of hospital stay.[174] Avoiding hypotension is the best prevention for postoperative nausea and vomiting (PONV).[77,78,174] Utilizing a multimodal approach is most effective in preventing PONV with a combination of agents such as serotonin antagonists (ondansetron, granisetron); dopamine antagonists (metoclopramide); and corticosteroids (dexamethasone).[77,78,174] The anesthesia professional may consider administering supplemental oxygen, acupressure, transdermal scopolamine patch (after umbilical cord clamping), and/or subhypnotic doses of propofol.[78,174]

Urinary Retention

- Observe parturient for evidence of bladder distention, especially if suprapubic pain occurs during contractions.[66]
- Inability to void and bladder distention should prompt bladder catheterization.[66]

Unintentional Dural Puncture

- In the event of an unintentional dural puncture, the anesthesia professional is required to disclose the dural puncture and inform the patient that they will be closely evaluated for signs and symptoms of a post-dural puncture headache while they are in the hospital and will receive appropriate management.
- Anesthesia professionals have two options after unintentional dural puncture(s):[66,107,175]
    - Remove and re-site the epidural needle and place the epidural catheter in a different vertebral interspace; or
    - Thread the epidural into the intrathecal space.

If the decision is to re-site the epidural catheter in a different vertebral interspace:[66,107,176]

- Upon visualization of CSF, immediately remove the epidural needle.
- Site the epidural catheter at a different interspace.
- It is not advisable to use loss of resistance with air technique on a repeat epidural after an inadvertent dural puncture due to the risk of pneumocephalus.

OR

If the decision is to thread the epidural catheter into the intrathecal space:[66,107,175]

- Upon visualization of CSF, thread the epidural catheter into the subarachnoid/intrathecal space.
- Secure intrathecal catheter using strict aseptic technique.
- Clearly label the spinal catheter at the syringe/infusion pump and communicate with anesthesia professionals and nursing personnel that catheter is intrathecal.
- Local anesthesia and neuraxial opioid administration via an intrathecal catheter should use spinal analgesia and anesthetic dosing (approximately 1/10th of epidural dosing).

Post-Dural Puncture Headache (PDPH)

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.[177-179]

Table 6. Prevention and management of PDPH[175,177-179]

Prevention	Management
• Use small, non-cutting spinal needle (e.g., 25 to 27 gauge)	• Adequate hydration • Analgesics

• Use ultrasound to provide guidance on patients with a difficult-to-palpate spine • Use smallest epidural needle available for adults (e.g., 17 to 18 gauge) • Scheduled non-opioid analgesia • Encourage parturient to hydrate, including caffeine beverages if tolerated • Use an intrathecal catheter • Consider IV cosyntropin or preservative-free epidural morphine	• Caffeine • Sumatriptan • Gabapentin • Sphenopalatine ganglion block • Epidural blood patch

Unintentional Subdural Injection

An unintentional subdural injection or threading of an epidural catheter is rare but can be initially recognized because the extent of the block is disproportionate to the amount of drug that is injected, as the limited capacity of the space results in extensive spread.[38] This can lead to significant hypotension, motor weakness in the intercostal muscle or direct nerve damage.[38,180] Consider the following steps if an accidental subdural injection occurs:[38,181]

- Disclose to patient and discuss steps for management.
- The epidural catheter should be removed and if mandatory be relocated to another space
- If a spinal anesthetic is planned, anticipate an enhanced cephalad spread secondary to possible compression of the subarachnoid space by the subdural injection.
- Monitor the patient closely and if a high sensory block develops, provide cardiovascular and respiratory support, as needed.

Aspiration Pneumonitis

Take precautions to prevent aspiration pneumonitis during pregnancy, labor, delivery, surgery and post-delivery. Medications (e.g., clear antacid, serotonin antagonist) and restricting solid foods before elective surgery can help prevent aspiration.[23,182] Manage cases of aspiration pneumonitis on an individual basis.[23,182]

Complications 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 of emergency equipment and supplies.[66,67,183,184] Standardization of care through clinical pathways and emergency checklists and bundles limits variation in care to improve delivery of care, safety, and patient outcomes.[77,137,185]

Emergency resources include, but are not limited to:

- ACOG Safe Motherhood Initiative Hypertension Bundle
- ACOG Safe Motherhood Initiative Hemorrhage Bundle
- ACOG Safe Motherhood Initiative 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 pregnancy[186]
- 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)

Response and Review of Emergencies

Establishing an obstetric rapid response team is recommended and can improve management of maternal and fetal complications and emergencies, which may lead to improved maternal, fetal, and neonatal outcomes.[63,67] An obstetric rapid response team is composed of healthcare professionals who train together to respond to early signs of maternal and fetal emergencies. A rapid response team may include 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.[63,187-189] Policy and criteria to activate the rapid response team is specific to each institution. The Joint Commission Provision of Care, Treatment, and Services standards for maternal safety require that "role-specific education to all staff and providers who treat pregnant/postpartum patients" is provided for obstetrical hemorrhage and hypertensive emergencies and that drills are conducted at least annually.[189]

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.[190] The primary responsibility of the anesthesia professional is to the maternal patient.[3,191] Another healthcare professional should be available whose sole responsibility is to care for the neonate.[192,193] Neonatal resuscitation should be conducted per institutional policy.

Difficult Airway Management

An anesthesia professional may be required to address airway emergencies during the peripartum period. Several physiologic and anatomic changes occur during pregnancy and should be considered when addressing ventilation and airway management of the parturient.[136] These changes include airway edema, weight gain, enlarged breasts, decreased lower esophageal sphincter tone and decreased gastric emptying, increased oxygen consumption, and decreased functional residual capacity.[136]

If an airway emergency occurs, the priority is effective ventilation for maternal and fetal oxygenation.[136] Considerations specific for the parturient airway include use of the sniffing position of the parturient, short laryngoscopy handle, video laryngoscopy, bougie, and/or a 6 mm endotracheal tube.[136,137] Mask ventilation with cricoid pressure to maintain oxygenation should be considered in the scenarios described in Table 7. Cricoid pressure may not be effective, and if ventilation or airway visualization is inadequate, consider removing cricoid pressure.[136]

Table 7. Obstetric airway emergency scenario considerations[136,137]

Scenario	Considerations

Can Ventilate Cannot Intubate	• Assess maternal and fetal status.
	• Mother and fetus at immediate risk.
	  ○ Continue ventilation until patient emerges and consider neuraxial technique or awake intubation
	  OR

Scenario	Considerations
	○ Continue anesthesia with mask ventilation with cricoid pressure assessing quality of ventilation and need for insertion of a supraglottic airway devise or surgical airway. • Mother or fetus in immediate danger. ○ Proceed to cesarean delivery with mask ventilation, cricoid pressure and determine if repeated intubation attempt is appropriate. ○ If not able to intubate, consider supraglottic device with gastric drainage port.
Cannot Ventilate or Intubate	• 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 may represent pre-existing chronic hypertension, gestational hypertension, or pregnancy-induced hypertension (also known as preeclampsia).[194] Appropriate management of hypertension requires prompt recognition, evaluation and treatment to prevent permanent end-organ damage.[194] Hypertension is defined as having a systolic blood pressure (SBP) above 140 mmHg or a diastolic blood pressure (DBP) above 90 mmHg.[194,195] Severe hypertension is a SBP above 160 mmHg or DBP above 110 mmHg.[194-196]

The following laboratory tests may be of value to identify the systemic effects of hypertension and to guide management.[194,195,197]

- 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.[194] Table 8 describes the characteristics of hypertensive disorders.

Table 8. Characteristics of hypertensive disorders[23,194-200]

Disorder	Diagnostic Criteria and Characteristics
Chronic Hypertension	• SBP greater than or equal to 140 mm Hg or DBP greater than or equal to 90 mm Hg. • Onset prior to pregnancy or less than 20 weeks gestation.
Gestational Hypertension	• SBP greater than or equal to 140 mm Hg or DBP greater than or equal to 90 mm Hg. • Onset after 20 weeks gestation, most cases develop at and after 37 weeks gestation. • Absence of proteinuria or systemic signs/symptoms.

Disorder	Diagnostic Criteria and Characteristics
Preeclampsia	• Risk factors: ○ Preeclampsia in a previous pregnancy ○ Multiparity ○ Pre-existing hypertension, diabetes, renal disease, vascular and connective tissue diseases ○ Advanced maternal age ○ Black race ○ Hispanic ethnicity ○ BMI greater than 35 • Diagnostic criteria: ○ SBP between 140 and 159 mmHg ○ DBP between 90 and 109 mmHg ○ Evidence of organ dysfunction and lab abnormalities • Symptoms: ○ Urine output: 30-49 mL/hour ○ Mild headache ○ Blurred or impaired vision ○ Nausea, vomiting, abdominal pain ○ Chest pain ○ Depression of patellar reflexes • Lab values: ○ Platelet count: less than 100,000 per microliter of blood ○ AST/ALT: 2 times normal value ○ Category II intrauterine fetal growth restriction ○ Creatinine: 1.1 mg/dL ○ Proteinuria: new onset 300mg/24 hours or worsening proteinuria*
Preeclampsia with Severe Features	• 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: ○ 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: ○ Unrelenting headache ○ Partial blindness or blind spots ○ Epigastric or right upper quadrant pain ○ Pulmonary edema ○ Urine output: less than 30 mL/hour
Eclampsia	• Preeclampsia with severe features plus: ○ 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 SBP range of 140-160 mmHg and DBP 90-100 mmHg to prevent repeated, prolonged exposure of the patient to signficiant hypertension with subsequent loss of cerebral vasculature autoregulation.[194,195,200,201] The use of guidelines or a checklist or cognitive aid for team training and use during the management of a hypertensive emergency, such as the ACOG Hypertensive Emergency checklist, has been shown to improve cerebral complications and outcomes (refer to *Appendix A. American College of Obstetricians and Gynecologists District II Safe Motherhood Initiative Maternal Safety Bundle for Severe Hypertension in Pregnancy: Hypertensive Emergency Checklist* for more detailed information).[63,189,195,197,198]

Close maternal and fetal monitoring are advised during the treatment of severe hypertension, and judicious fluid administration is recommended even in the case of oliguria.[194] Table 9 provides therapeutic recommendations for treatment of maternal hypertension and anticonvulsant prophylaxis and management.

Table 9. Hypertension therapy and seizure prophylaxis and management[194,195,197,198,200-202]

Antihypertensive Medications
If severe elevations (SBP ≥ 160 or DBP ≥ 110) persist for 15 minutes (min) or more (two severe readings less than 60 minutes apart) OR if two severe elevations are obtained within 15 min and treatment is clinically indicated. *Notes:* • *Notify obstetric provider after one severe BP value is obtained* • *Institute fetal surveillance if viable* • *Avoid labetalol in patients with active asthma, heart disease, or heart failure* • *Maximum cumulative IV-administered labetalol should not exceed 300 mg in 24 hours* • *Hold IV labetalol for maternal pulse under 60 bpm* • *If no IV access is available, initiate algorithm for oral nifedipine **or** give 200 mg oral labetalol (repeat in 30 min if SBP ≥ 160 or DBP ≥ 110 and IV access still unavailable)* **Labetalol Algorithm** 1. 20 mg IV over 2 min, repeat BP in 10 min 2. 40 mg IV over 2 min *if* SBP ≥ 160 or DBP ≥ 110, repeat BP in 10 min 3. 80 mg IV over 2 min *if* SBP ≥ 160 or DBP ≥ 110, repeat BP in 10 min 4. 10 mg **hydralazine** IV over 2 min *if* SBP ≥ 160 or DBP ≥ 110, repeat BP in 20 min 5. If in 20 min SBP ≥ 160 or DBP ≥ 110, obtain emergency consult from specialist in maternal fetal medicine (MFM), internal medicine, anesthesia, or critical care 6. Give additional antihypertensive medication per specialist order 7. Once BP thresholds are achieved, repeat BP: a. Every 10 min for 1 hour b. Then every 15 min for 1 hour c. Then every 30 min for 1 hour d. Then every hour for 4 hours 8. Institute additional BP monitoring per specific order **Hydralazine Algorithm** 1. 5 or 10 mg IV over 2 min, repeat BP in 20 min

2. 10 mg IV over 2 min *if* SBP ≥ 160 or DBP ≥ 110, repeat BP in 20 min
3. 20 mg **labetalol** IV over 2 min *if* SBP ≥ 160 or DBP ≥ 110, repeat BP in 10 min
4. 40 mg **labetalol** IV over 2 min *if* SBP ≥ 160 or DBP ≥ 110, obtain emergency consult from specialist in MFM, internal medicine, anesthesia, or critical care
5. Give additional antihypertensive medication per specialist order
6. Once BP thresholds are achieved, repeat BP:
    a. Every 10 min for 1 hour
    b. Then every 15 min for 1 hour
    c. Then every 30 min for 1 hour
    d. Then every hour for 4 hours
7. Institute additional BP monitoring per specific order

Oral Nifedipine Algorithm

1. 10 mg, repeat BP in 20 min
2. 20 mg *if* SBP ≥ 160 or DBP ≥ 110, repeat BP in 20 min
3. 20 mg *if* SBP ≥ 160 or DBP ≥ 110, repeat BP in 20 min
4. 20 mg **labetalol** IV over 2 min *if* SBP ≥ 160 or DBP ≥ 110
5. *If* SBP ≥ 160 or DBP ≥ 110, obtain emergency consult from specialist in MFM, internal medicine, anesthesia, or critical care
6. Give additional antihypertensive medication per specialist order
7. Once BP thresholds are achieved, repeat BP:
    a. Every 10 min for 1 hour
    b. Then every 15 min for 1 hour
    c. Then every 30 min for 1 hour
    d. Then every hour for 4 hours
8. Institute additional BP monitoring per specific order

Sodium Nitroprusside

Consider for exterme emergencies

1. 0.25 to 5 mcg/kg/min IV infusion (risk of fetal cyanide toxicity if used > 4 hours)

Anticonvulsant Prophylaxis and Management

Notes:

- *It is the responsibility of the CRNA to understand the information obtained from deep tendon reflexes and magnesium sulfate levels in order to treat the patient.*
- *Magnesium sulfate should be used for seizure prophylaxis and treatment, and is not recommended as an antihypertensive agent.*

Intravenous Magnesium Sulfate (20 g/500 mL bag)

- 4-6 g IV bolus in 100 mL over 20 min, followed by IV infusion of 1-2 g/hr. Continue for 24 hours postpartum.
- Contraindicted in pulmonary edema, renal failure, myasthenia gravis.

Magnesium Overdose Management

Intravenous Calcium Gluconate (1 g over 10 min)

For recurrent seizures or when magnesium sulfate is contraindicated

- **Lorazepam IV**
  - 2-4 mg IV x 1, may repeat x 1 after 10-15 min
- **Diazepam IV**
  - 5-10 mg IV every 5-10 min to max dose 30 mg
- **Phenytoin IV**
  - 15-20 mg/kg IV x 1, may repeat 10 mg/kg IV after 20 min if no response. Avoid with hypotension, may cause cardiac arrhytmias.
- **Keppra IV or Oral**
  - 500 mg IV or orally, may repeat in 12 hours. Dose adjustment needed if renal impariment.

Seizure Management

- Maintain airway patency and breathing
- Position maternal patient on side and protect from injury
- Assess neurologic function
- Provide acute seizure control with IV magnesium sulfate for initial and first recurrent seizure
  - If maternal patient experiences a second recurrent seizure after second loading dose of magnesium sulfate, administer midazolam, diazepam, phenytoin, **or** propofol
- 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[194,201]
  - Neuraxial technique is preferred for vaginal delivery and cesarean delivery 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.[203]
- General anesthesia[194,200,201]
  - Clinical indications include severe maternal hemorrhage, sustained fetal bradycardia, severe thrombocytopenia or other coagulopathy.
  - Preemptively 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[194,204]
  - 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[194,200]
  - Monitor blood pressure until stable.
  - Consult the obstetric provider for administrating NSAIDs in the hypertensive patient.

Obstetric Hemorrhage

Obstetric hemorrhage is defined as severe bleeding during pregnancy, labor, or in the postpartum period that may become life-threatening.[168,205] Risk factors for obstetric hemorrhage include, but are not limited to:[168,187,205-207]

- 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, accreta, 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.

Consider not giving NSAIDs to any patient with suspected or active hemorrhage. Antepartum hemorrhage is defined as bleeding from or into the genital tract, which can occur any time during pregnancy, until childbirth.[168] If not addressed, antepartum hemorrhage can result in postpartum hemorrhage.[168] Antepartum hemorrhage can be related to several conditions summarized in Table 10.

Table 10. Presentation of antepartum hemorrhage[168,187]

Condition	Presentation

Placenta Previa	• Present when placenta implants in advance of fetal presenting part.
	  ○ 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.

Placental Abruption	• Complete, partial, or marginal separation of the placenta from the decidua basalis before delivery.

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Condition	Presentation
	• Vaginal bleeding may be present or may be concealed behind the placenta. • May be associated with a significant amount of pain
Uterine Rupture	• 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	• Velamentous insertion of the fetal vessels over the cervical 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.[168,205] Postpartum hemorrhage is related to one or more of four conditions:[168,205,206,208]

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.[63,168,189] 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.[68,168,209] 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 B. American College of Obstetricians and Gynecologists Maternal Safety Bundle for Obstetric Hemorrhage: Hemorrhage Checklist* for more detailed information).[63,68,183,189] Steps and considerations for anesthesia management of obstetric hemorrhage include:[168,183,207]

- Large bore vascular access; consider arterial line.
- Initiate systematic approach to manage hemorrhage, such as an institutional Massive Transfusion Protocol (MTP) blood products and factors.[209]
    - Review *Appendix C. ACOG Bundle on Obstetric Hemorrhage: Mass Transfusion Protocol*.
    - Consider prophylactic Tranexamic Acid (TXA) for patients at risk for hemorrhage and consider treatment with TXA within 30 minutes of hemorrhage.[210]
        - Discuss prophylactic and treatment plan with the obstetric provider.
- 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.[211] 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.[48] Increases in cardiac arrest are associated with obstetric patients of advanced maternal age and/or with chronic health conditions.[212-214] Rapid recognition and response to a cardiac arrest can be critical in improving the outcomes for both the mother and the fetus.[67] 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.[211] It is essential that oxygenation and ventilation are quickly restored while maintaining cricoid pressure.[211]

Fetal outcome is related to the time from onset of maternal cardiac arrest to delivery and gestational age.[186,213] 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.[186] Immediate surgical delivery should be considered if spontaneous circulation does not return within four to five minutes of cardiopulmonary resuscitation.[211,213]

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.[99,215] 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:[216-219]

- 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 of Amniotic Fluid Embolism

When amniotic fluid embolism is suspected, it is important to take immediate action. Immediate notification includes a team-based approach involving nursing and respiratory therapy, along with specialists in neonatology, maternal-fetal medicine, obstetrics, anesthesia, and intensive

care.[99,216,219] Maternal resuscitation focuses on oxygenation, hemodynamic support, and correction of coagulopathy.[99] If disseminated intravascular coagulation (DIC) develops, be vigilant for development of an epidural hematoma if an epidural was recently inserted. Consider the following management:[99,218,219]

- Airway
  - Administer 100% oxygen.
  - Intubate the trachea, support ventilation as needed.
  - Maintain a pulse oximetry value of >96%.
- Cardiovascular Support
  - Large-bore intravenous access.
  - Aggressive hemodynamic support with fluids and vasopressors.
  - Left uterine displacement is crucial in resuscitation efforts if the fetus remains in utero.
  - Consider invasive blood pressure monitoring.
  - Start chest compressions, if indicated.
  - Following cardiac arrest, immediately deliver fetus if more than 22 to 23 weeks gestation.
- Hemostatic Support
  - Activate the obstetric hemorrhage protocol and massive transfusion protocol.
  - Ensure normothermia.
  - Complete serial laboratory assessment to monitor for coagulopathy and electrolyte disturbances.
  - Consider TXA, recombinant human factor VIIa, prothrombin complex concentrate, and fibrinogen concentrate for coagulopathy associated with amniotic fluid embolism.
  - Ventricular assist device, cardiopulmonary bypass, or extracorporeal membrane oxygenation may be required.

Consider administration of the “A-OK” medication regimen, which reports have shown to have led to restoration of a patient’s circulation and successful resuscitation.[38,215,220] References differ on dosing, but this protocol consists of atropine 0.2 to 1 mg (treats vagal overstimulation and improves motor tone), ondansetron 8 mg (serotonin antagonist, blocks release of further mediators), and ketorolac 15 to 30 mg (cyclooxygenase inhibitor, blocks thromboxane production preventing coagulopathy).[38,215,220]

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, equitable, and 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 Anesthesiology, 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), American Society of Regional Anesthesia and Pain Medicine (ASRA), and the Association of Women’s Health, and

Obstetric and Neonatal Nurses (AWHONN). As the breadth and depth of obstetric analgesia and anesthesia continue 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 District II Safe Motherhood Initiative Maternal Safety Bundle for Severe Hypertension in Pregnancy: Hypertensive Emergency Checklist

Hypertensive Emergency:

- Two severe BP values (≥160/110) taken 15-60 minutes apart. Values do not need to be consecutive.
- May treat within 15 minutes if clinically indicated

- ☐ **Call for assistance**
- ☐ **Designate**:
  - Team leader
  - Checklist reader/recorder
  - Primary RN
- ☐ Ensure side rails up
- ☐ Ensure medications appropriate given patient history
- ☐ Administer seizure prophylaxis (magnesium sulfate first line agent, unless contraindicated)
- ☐ Antihypertensive therapy within 1 hour for persistent severe range BP
- ☐ Place IV; Draw preeclampsia labs
- ☐ Antenatal corticosteroids (if <34 weeks of gestation)
- ☐ Re-address VTE prophylaxis requirement
- ☐ Place indwelling urinary catheter
- ☐ Brain imaging if unremitting headache or neurological symptoms
- ☐ Debrief patient, family, and obstetric team

Magnesium Sulfate *[for seizure prophylaxis and treatment]*
Contraindications: Myasthenia gravis; avoid with pulmonary edema, use caution with renal failure

- ☐ IV access:
  - Load 4-6 grams 10% magnesium sulfate in 100 mL solution over 20 minutes
  - Label magnesium sulfate; Connect to labeled infusion pump
  - Magnesium sulfate maintenance 1-2 grams/hour
- ☐ No IV access:
  - 10 grams of 50% solution IM (5 g in each buttock)

Antihypertensive Medications
For SBP ≥ 160 or DBP ≥ 110
(See Safe Motherhood Initiative algorithms for complete management when necessary to move to another agent after 2 doses.)

- ☐ **Labetalol** (initial dose: 20 mg)
  - Avoid parenteral labetalol with active asthma†, heart disease, or congestive heart failure; use with caution with history of asthma
- ☐ **Hydralazine** (5-10 mg IV* over 2 min)
  - May increase risk of maternal hypotension
- ☐ **Oral Nifedipine** (10 mg capsules)
  - Capsules should be administered orally, not punctured or otherwise administered sublingually

Note: *If first line agents unsuccessful, emergency consult with specialist (MFM, internal medicine, OB anesthesiology, critical care) is recommended*

Anticonvulsant Medications
For recurrent seizures or when magnesium sulfate contraindicated

	☐ **Lorazepam** (Ativan): 2-4 mg IV x 1, may repeat once after 10-15 min ☐ **Diazepam** (Valium): 5-10 mg IV q 5-10 min to maximum dose 30mg

† "Active asthma" is defined as:
a. Symptoms at least once a week, or
b. Use of an inhaler, corticosteroids for asthma during the pregnancy, or
c. Any history of intubation or hospitalization for asthma.

** Maximum cumulative IV-administered doses should not exceed 220 mg labetalol or 25 mg hydralazine in 24 hours.*

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Appendix B. American College of Obstetricians and Gynecologists District II Safe Motherhood Initiative Maternal Safety Bundle for Obstetric Hemorrhage: Hemorrhage Checklist

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

<table>
<tr><td>Recognition</td><td colspan="2">☐ Call for assistance (obstetric hemorrhage team)
☐ Designate:
• Team leader
• Checklist reader/recorder
• Primary RN
☐ Announce:
• Cumulative blood loss
• Vital signs
• Determine stage</td></tr>
<tr><td>Hemorrhage Cart</td><td colspan="2">Vaginal
☐ Vaginal retractors, long weighted speculum
☐ Long instruments (needle holder, scissors, Kelly clamps, sponge forceps)
☐ Intrauterine balloon
☐ Banjo curette
☐ Bright task light
☐ Procedural instructions (balloon)

Cesarean/Laparotomy
☐ Hysterectomy tray
☐ #1 chromic or plain catgut suture and reloadable straight needle for B-lynch sutures
☐ Intrauterine balloon
☐ Procedural instructions (balloon, B-Lynch, arterial ligations)</td></tr>
<tr><td>Checklist: Stage 1

Blood loss >500 mL vaginal

OR

Blood loss >1000 mL cesarean with normal vital signs and lab values</td><td>Initial Steps
☐ Ensure 16G or 18G IV access
☐ Increase IV fluid (crystalloid without oxytocin)
☐ Insert indwelling urinary catheter
☐ Fundal massage
Medications (see right box)
☐ Increase oxytocin, additional uterotonics
Blood Bank
☐ Type & crossmatch 2 units RBCs
Action
☐ Determine etiology & treat</td><td>Medications:
• Oxytocin (Pitocin)
○ 10-40 units per 500-1000mL solution
• Methylergonovine (Methergine)
○ 0.2 milligrams IM (may repeat)
• 15-methyl PGF2α (Hemabate, Carboprost)
○ 250 micrograms IM (may repeat in q15 minutes, maximum 8 doses)
• Misoprostol (Cytotec)
○ 800-1000 micrograms PR
○ 600 micrograms PO or 800 micrograms SL</td></tr>
</table>

	☐ Prepare OR, if clinically indicated (optimize visualization/examination)	
Checklist: Stage 2 Continued bleeding EBL up to 1500mL **OR** >2 uterotonics with normal vital signs and lab values	**Initial Steps** ☐ Mobilize additional help ☐ Place 2nd IV (16-18g) ☐ Draw STAT labs (CBC, Coags, Fibrinogen) ☐ Prepare OR **Medications** ☐ Continue stage 1 medications; consider TXA **(see right box)** **Blood Bank** ☐ Obtain 2 units red blood cells (do not wait for labs. Transfuse per clinical signs/symptoms) ☐ Thaw 2 units fresh frozen plasma **Actions** ☐ For uterine atony → consider uterine balloon or packing, possible surgical interventions ☐ Consider moving patient to operating room ☐ Escalate therapy with goal of hemostasis Huddle and move to Stage 3 if continued blood loss and/or abnormal VS	**Transexamic Acid (TXA)** • 1 gram IV over 10 min (add 1 gram vial to 100mL normal saline and give over 10 min; may be repeated once after 30 min) **Possible interventions:** • Bakri balloon • Compression suture/B-Lynch suture • Uterine artery ligation • Hysterectomy
Checklist: Stage 3 Continued bleeding with EBL >1500mL OR >2 units RBCs given **OR** Patient at risk for occult bleeding or coagulopathy **OR** Patient with abnormal vital signs/labs/oliguria	**Initial Steps** ☐ Mobilize additional help ☐ Move to OR ☐ Announce clinical status (vital signs, cumulative blood loss, etiology) ☐ Outline & communicate plan **Medications** ☐ Continue Stage 1 medications; consider TXA **Blood Bank** ☐ Initiate massive transfusion protocol ☐ If clinical coagulopathy: add cryoprecipitate, consult for additional agents **Action** ☐ Achieve hemostasis, interventions based on etiology ☐ Escalate interventions	
Checklist: Stage 4 Cardiovascular Collapse (massive	**Initial Steps** ☐ Mobilize additional resources **Medications** ☐ ACLS	

hemorrhage, profound hypovolemic shock, or amniotic fluid embolism)	**Blood Bank** □ Simultaneous aggressive massive transfusion **Action** □ Immediate surgical intervention to ensure hemostasis (hysterectomy)
Post-Hemorrhage Management	□ Determine disposition of patient (whether ICU required) □ Debrief with the whole obstetric care team □ Debrief with patient and family □ Document information in patient medical record
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Appendix C. American College of Obstetricians and Gynecologists District II Safe Motherhood Initiative Bundle on Obstetric Hemorrhage: Mass Transfusion Protocol

Blood Bank: Massive Transfusion Protocol

In order to provide safe obstetric care, institutions must:

- Have a functioning Massive Transfusion Protocol (MTP).
- Have a functioning Emergency Release Protocol (a minimum of 4 units of O-negative or uncrossmatched red blood cells).*
- Have the ability to obtain 6 units PRBCs and 4 units FFP (compatible or type specific) for a bleeding patient.
- Have a mechanism in place to obtain platelets and additional products in a timely fashion.
- Blood transfusion or cross-matching should not be used as a negative quality marker & is warranted for certain obstetric events.

Important protocol items to be determined at each institution are:

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 the 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

I. Patient currently bleeding & at risk for uncontrollable bleeding

1. Activate MTP –call (add number) and say “activate massive transfusion protocol”
2. Nursing/Anesthesia draw stat labs
   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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