

recommended for antibiotic prophylaxis by the American College of Obstetrician and Gynecologist (ACOG).⁶ Extended-spectrum antibiotic regimen is recommended for active or presumed infection.

Intravenous Fluid

A wide bore intravenous cannula should be secured and non-dextrose containing balanced salt solution started. Crystalloid in a dose of 15–20 mL per kg of body weight should be infused before the neuraxial block as preload. In case of emergency, fluid can be administered simultaneously with neuraxial block as co-load. One should not wait to infuse fixed volume of fluid to prevent hypotension. Either of above technique is effective in preventing hypotension.⁷ Vasopressor can be given for its prophylaxis and treatment.⁸ Any crystalloid or colloid fluid would be effective to maintain the intravascular volume.⁹ The incidence of hypotension is not eliminated with crystalloid or colloid infusion but the severity of hypotension definitely decreases. Type of fluid, volume, rate and timing of infusion are important factors in the prevention and treatment of hypotension. Ripolles et al¹⁰ reviewed and found on meta-analysis that colloid administration significantly reduces the incidence of hypotension associated to spinal anesthesia in elective cesarean section compared with use of crystalloid. Colloid is of advantage when given simultaneously while performing neuraxial block because it stays for a longer time in intravascular compartment. Its disadvantages are that it is expensive, associated with increased risk of pulmonary edema after delivery due to contracting uterus (autotransfusion) and there is risk of anaphylactoid reaction. Non-dextrose-containing balanced salt solution should be infused within 30 minutes of providing anesthesia to maintain intravascular volume. Dextrose-containing fluid may stimulate fetal insulin secretion and will result into fetal hypoglycemia and

hyponatremia. Calcium- or dextrose-containing fluid should not be infused with blood products because of risk of intravascular clotting and clumping of red blood cell.

We prefer preloading or coload with Ringer's lactate solution over colloid, which effectively reduces the incidence of hypotension. We reserve colloid administration only for those cases, which are at high risk of developing hypotension, or require rapid maintenance of effective intravascular volume.

Monitoring

Standard monitoring includes pulse oximetry, ECG, heart rate (HR), NIBP, temperature, and urine output. Invasive blood pressure monitoring is required in case of severely compromised cardiac disease, refractory hypertension, pulmonary edema or unexplained oliguria, and severe hypovolemic maternal condition. Abnormal ECG is commonly seen in late trimester due to hyperdynamic circulation, circulating catecholamines and altered estrogen and progesterone ratios. Myocardial ischemia may be experienced in small number of patients during CS.¹¹ Shen et al¹² performed a study on 254 healthy pregnant patients who had undergone spinal anesthesia for cesarean section. They found the incidence of first and second degree atrioventricular block (3.5% each), severe bradycardia (<50 beats/min; 6.7%) and multiple premature ventricular contraction (1.2%). The above increased parasympathetic activity occurred due to blockade of cardiac sympathetic activity post-spinal anesthesia. These types of arrhythmias were transient and resolved spontaneously. Urine output measurement is one of the indicators of systemic perfusion and renal function.

ANESTHESIA TECHNIQUES FOR CS

Type of anesthesia care depends upon the condition of maternal and fetal wellbeing and

The onset and level of anesthesia are achieved slowly in EA and depending upon the duration of surgery it can be maintained for longer time. If initial dose of local anesthetic does not provide significant sensory block, administering more drug through the catheter can increase the height of block. Touhy needle is being used for administering epidural anesthesia. Epidural catheter can be kept for postoperative analgesia. Caudal epidural anesthesia may be used for cesarean section but not very popular due to difficulty in placing the catheter.

Local anesthetic and adjuvant in EA: 2% adrenalized lidocaine is most commonly used local anesthetic in epidural anesthesia. It provides faster onset and additional dose can be given to get adequate height of block. Test dose of 3 mL of 2% adrenalized lidocaine should be given prior to total epidural dose to exclude the intravascular or intrathecal placement of the catheter. Tachycardia within 30 seconds of administration of test dose indicates intravascular placement of epidural catheter. Usually 20 mL volume of local anesthetic agent is sufficient to get the desired T4 level of anesthesia. Other local anesthetic agents are bupivacaine (0.5%), ropivacaine (0.5–0.75%) and 2-chloroprocaine (3%). Bupivacaine has slow onset and longest duration of action. 0.75% bupivacaine used for CS may produce a denser block but this concentration is not preferred in obstetric patients for fear of cardiac arrest owing to accidental intravascular injection.

Sodium bicarbonate increases the pH of local anesthetic solution, therefore, a higher fraction of non-ionized lipid-soluble drug is available for action. Mixing of 2 mL 8.4% of sodium bicarbonate to every 20 mL of lidocaine or 2-chloroprocaine and 0.1 to 20 mL bupivacaine solution is advised.¹⁹ But its disadvantage is rapid development of hypotension and consequently decreased uteroplacental circulation. Hence should be used with caution in high-risk obstetric patient.

Epinephrine, a vasoconstrictor agent, in concentration of 1 in 2,00,000 is added to local anesthetic. It decreases the systemic absorption of local anesthetics thus decreasing the peak blood levels. It intensifies the motor block and prolongs the duration of anesthesia. It is also used as a test dose in concentration of 5 µg/mL with lidocaine to identify intravascular placement.

Epidural opioids, fentanyl 50–100 µg potentiates intraoperative analgesia and decreases nausea and vomiting due to visceral manipulation with no adverse effects on maternal and fetal outcome. Other opioids, such as sufentanil 20–30 µg, morphine 2–5 mg and buprenorphine 90–150 µg, are also used as an adjuvant to local anesthesia. Sufentanil has property of profound analgesia and provides good intraoperative anesthesia. If added to local anesthetic agents. It has minimal maternal side effects and no untoward effects on fetus. Morphine provides effective, safe, prolong and profound analgesia (24 hours) with mild adverse effects. Postoperative monitoring is needed in case of opioid adjuvants.

Position of the patient at the time of induction and effect of gravity influences the quality of block. The epidural catheter should be placed at a proper level of required anesthesia to avert catastrophes of total spinal, convulsion or cardiac arrest can happen.

Combined Spinal Epidural Anesthesia

Combined spinal epidural (CSE) anesthesia has gained popularity because it has advantages of both spinal as well as epidural anesthesia. It eliminates the individual disadvantages of spinal and epidural anesthesia when used as a sole technique. CSE provides fast onset, extended duration of anesthesia and postoperative pain relief. It causes less hypotension and can be managed easily. CSE can be given through double interspace technique or single interspace technique (needle through needle technique).

anesthetic techniques (general as well as neuraxial) are good and provide effective anesthesia. Most of the anesthesiologist prefers to give SA over GA as single drug provides fast and adequate anesthesia. Other reason of preferring SA over GA is incidence of unanticipated difficult airway in parturients while providing general anesthesia can be avoided. Depressant action of various drugs on fetus can be avoided by not administering general anesthesia. Some anesthesiologists prefer GA for fetal distress as it takes less time to induce the parturient than SA. Time is an important issue, SA failure may occur and it may require administration of GA to the patient. Within the neuraxial technique, SA is preferred over epidural anesthesia, as placing the epidural catheter is time consumable procedure. However, labor epidural can be used to extend the anesthesia.

POSTPARTUM TUBAL LIGATION (PTL)

Postpartum period or postnatal period starts immediately after the delivery of baby and extends up to 6–8 weeks. During this period, maternal hormones and pregnant physiological state return to non-pregnant physiological state.

For initial few days, the physiological state of post-pregnancy is same to the pregnant state. Atrophy of uterus starts from 2nd day and continues till 6–8 weeks. The blood volume is increased to 15–35% due to autotransfusion and started declining to non-pregnant state within 2–3 weeks. Due to increased blood volume, cardiac output is also increased. Hematocrit may be low due to blood loss during vaginal and cesarean deliveries. White blood cell count may remain high (20,000–30,000 per cumm), especially neutrophil count. Respiratory changes such as increased ventilatory drive, laryngeal and pharyngeal edema of pregnant state will remain there for few days. Laryngeal and pharyngeal edema may put the patient at an increased risk of upper airway infection.

Laryngitis, nasal congestion and voice changes are common presentation.

Spinal anesthesia is considered to be the safe and effective procedure and it has been most commonly used method for providing anesthesia for postpartum tubal ligation. Epidural anesthesia can be used, if epidural catheter has been placed earlier for labor analgesia or for cesarean section and remain *in situ* for providing postoperative analgesia. Epidural anesthesia has not been used solely for PTL because PTL is a short duration procedure. General anesthesia is reserved only for those cases where the spinal anesthesia is contraindicated such as coagulopathy, infection at the site and increased intracranial tension. If GA has been chosen for administering anesthesia for PTL, laryngoscopy should be gentle to avoid injury to the pharyngeal structures. If planning for early PTL, ideally 8 hours should be completed between the delivery and scheduled tubal ligation. This period is most preferred time of doing PTL because during this time uterus remains extra-pelvic and its fundus is at the umbilicus, therefore, easy to catch hold fallopian tube of both sides.

ASA Guidelines for Postpartum Tubal Ligation

- Oral intake of solid foods should be stopped 6 h prior to surgery.
- Aspiration prophylaxis should be administered.
- Time of procedure and type of anesthesia technique for PTL should be based on obstetric risk factor, anesthesia risk factors and patient preferences.
- Neuraxial techniques are preferred to general anesthesia for most postpartum tubal ligations.
- Gastric emptying will be delayed in patients who have received opioids during labor.
- There may be failure of induction through epidural catheter, if it has placed earlier for labor analgesia, due to longer postdelivery time interval.

Cardiovascular Disease and Pregnancy

Sona Dave, Minal Harde

Pregnancy imposes unique physiological strains on the cardiovascular system which are magnified in presence of heart diseases. Maintaining maternal cardiovascular stability with adequate placental perfusion can be challenging. Many mothers are asymptomatic and the physiological changes of pregnancy may precipitate decompensation. The risk and the preferred anesthetic techniques differ amongst the various cardiac conditions. Goal of anesthetic management is to maintain hemodynamic parameters within a narrow therapeutic range. The risk in mother and fetus doubles increasing the peripartum morbidity and mortality. Thus multidisciplinary planning should be at the helm of peripartum management.¹

Cardiac disease in pregnancy accounts for 0.1–4% in the developed nations of which 70–80% are patients with congenital heart disease who survive to adulthood because of better surgical techniques and newer and better drugs. As women present at a much advanced age in recent times ischemic heart disease also may complicate pregnancies.¹ There is usually deterioration by 1 grade (NYHA class) during pregnancy in patients with pre-existing cardiac disease (Table 13.1).¹

While assessing a pregnant patient certain warning signs may point to a cardiac pathology in an otherwise unsuspected case.

- A rising pulse rate may be a harbinger of cardiac decompensation. The radial pulse is difficult to detect when the heart rate is fast or irregular. Hence, auscultating the heart with a stethoscope is more prudent and accurate.
- The blood pressure (BP) should be recorded with the woman sitting comfortably with a manual sphygmomanometer with an appropriate-sized cuff. The arm should be at an angle and supported to ensure that the cuff is at the level of the left atrium.

Table 13.1: New York Heart Association (NYHA)—functional classification

NYHA Class	Symptoms
I	No symptoms and no limitations on ordinary physical activity
II	Ordinary activity may cause mild symptoms and slight limitation
III	Marked limitation in activity. Less than ordinary activity will cause symptoms
IV	Severe limitations and symptoms at rest

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