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Obstetric Anesthesiologists as Perioperative Physicians: Improving Peripartum Care and Patient Safety

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Abstract The care of obstetric patients has become challenging due to the changing demographics of the pregnant population. Women with chronic diseases and congenital heart disease live to child-bearing age due to medical and surgical advances. Older and less healthy women become pregnant due to advances in reproductive technologies. Therefore, obstetric anesthesiologists have an increasingly important role in the peripartum period. In this article, we review the role of obstetric anesthesiologists in the antepartum, intrapartum, and postpartum periods. The need for multidisciplinary care of high-risk parturients is discussed, including the role of anesthesiologists in the National Maternal Health Initiative to improve maternal morbidity and mortality.

Keywords Perioperative · Obstetric anesthesia · Multidisciplinary · Maternal mortality · Ultrasound · Postpartum analgesia

Introduction

As patients become progressively more complex and high-risk, anesthesiologists play a vital role as perioperative physicians. Labor and delivery are dynamic times when emergencies and crises occur, and care must be delivered quickly and effectively. Care of the parturient is a team effort, and anesthesia providers are leaders in resuscitation and intensive care for critically ill patients. Thus, the anesthesiologist's role extends far beyond performing labor epidural analgesia and administering anesthetics for cesarean delivery. Obstetric anesthesia fellowship training has allowed for further knowledge and skills in managing high-risk parturients. Technological advances have allowed anesthesiologists to integrate ultrasound into the labor and delivery floor to facilitate procedures and diagnose and manage hemodynamically unstable patients [1]. The emphasis on patient safety in medicine has demanded quality control and improvement, and anesthesiologists have developed simulation programs for education and team training [2]. This article reviews the changing role of obstetric anesthesiologists in the antepartum, intrapartum, and postpartum periods.

Multidisciplinary Delivery Planning of High-Risk Antepartum Patients: Coordination of Care

Early antepartum anesthesiology referral of high-risk parturients is essential to multidisciplinary delivery and postpartum care planning [3, 4]. The proportion of pregnant women with high-risk comorbidities has been increasing

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over the past decade; these conditions include chronic hypertension, pregestational or gestational diabetes mellitus, chronic cardiovascular disease, pulmonary hypertension, chronic lung disease, adult congenital cardiac repair, human immunodeficiency virus, preeclampsia, obesity, multiple gestation, and advanced maternal age [5–8]. Evaluation by an anesthesiologist, and possibly other specialists, such as cardiologists, pediatric cardiologists, pulmonologists, and hematologists may be important in coordinating delivery and postpartum planning.

Labor analgesia plays an important role in the delivery of many high-risk parturients. Neuraxial analgesia is the most effective method of labor analgesia and supported by the American College of Obstetricians and Gynecologists (ACOG) [9]. Excellent pain relief can be especially important in providing hemodynamic stability during the first stage of labor for parturients with cardiovascular comorbidities, as well as providing analgesia for an assisted second stage of delivery [4, 10]. However, a patient may have a contraindication to a neuraxial technique that may or may not be related to the patient's high-risk condition. For example, patients with prior spine surgery or spine deformities often do well with neuraxial techniques, but may have difficult epidural placement, ineffective epidural analgesia, unintentional dural puncture, and potentially, infection of indwelling hardware [11, 12]. Patients with neurologic conditions with a risk of cerebral herniation following intentional or unintentional dural puncture are also poor candidates for neuraxial techniques [13]. Thus, anesthesiology consultation is imperative to investigate whether neuraxial techniques are likely to be possible or effective, and to discuss alternative options for analgesia.

Pregnant patients receiving anticoagulant medications may have contraindications to neuraxial techniques depending on the amount and timing of doses, and the particular medications prescribed. Although the American Society of Regional Anesthesia (ASRA) guidelines are available for commonly used anti-coagulants [14], new anti-coagulations for patients with atrial fibrillation and venous thromboembolism, such as dabigatran and rivaroxaban, have emerged. Studies regarding the risk of epidural hematoma and guidelines for timing of neuraxial techniques are not yet available for these new medications.

Although early antepartum multidisciplinary planning is optimal, patients may present for the first time near term and/or in labor. A recent review of all high-risk antenatal anesthesiology consultations at one center reported that only 24.7 % of eligible women for antepartum high-risk obstetric anesthesia consultation were seen in the antepartum clinic [15]. One-third of hospitals have fewer than 500 deliveries per year [16], thus limited access to large maternity units that function as high-risk centers may decrease the opportunities for high-risk patients to receive appropriate antepartum evaluation. When multidisciplinary delivery planning occurs in advance, arrival of the patient to labor and delivery entails execution of a pre-determined plan. But for patients without early anesthesiology consultation, initial impromptu multidisciplinary planning may be needed, possibly followed by immediate intervention.

Multidisciplinary Management of High-Risk Parturients

Overview

Although maternal morbidity has declined globally, there has been an increase in maternal morbidity and mortality in the United States over the last 20 years [17]. Data from the United States Nationwide Inpatient Sample, which included 8.5 million hospital deliveries from 1999 to 2008, revealed a doubling in the incidence of severe maternal postpartum hemorrhage (PPH) over a 10-year period [18]. Maternal deaths from preexisting medical conditions including cardiopulmonary and neurological disorders are also rising [19]. These data have led to an increasing emphasis on national quality improvement in patient safety within the practices of obstetrics and obstetric anesthesia. Studies suggest between 28 and 50 % of maternal deaths are preventable [19]. The most preventable errors have been shown to include failures to diagnose and treat pulmonary edema in women with preeclampsia, a failure to control blood pressure in hypertensive parturients, and a failure to monitor hemodynamic stability and hemorrhage after cesarean delivery [20]. In 2010, the Joint Commission on the Accreditation of Healthcare Organizations issued a Sentinel Alert entitled "Preventing Maternal Death," proposing initiatives to decrease maternal mortality [21]. Despite this call to action, a survey conducted between October and December 2012 revealed at least 20 % of United States academic obstetric anesthesia units still lacked PPH protocols [22].

In 2012, The National Partnership for Maternal Safety (NPMS) was formed. Comprised of leaders from various organizations dedicated to women's health, hospital organizations, and state, federal and regulatory governing bodies, their focus was to develop strategies to improve maternal health and safety in the United States [23••]. The group identified the need for patient "safety bundles" consisting of protocols for managing obstetrical emergencies. The first bundles were to address the most common, preventable causes of maternal morbidity and mortality: obstetric hemorrhage, severe hypertension, and venous thromboembolism. Multidisciplinary working groups were formed to address these three issues, as well as three supplemental patient safety bundles: (1) a structured approach

to recognize maternal early warning signs and symptoms of acute illness, (2) structured internal case reviews to identify system-improvement opportunities, and (3) support tools for patients, families, and staff experiencing adverse outcomes [23••, 24]. The involvement of anesthesiologists in creating and implementing these bundles has been essential, as they are integral in managing obstetric emergencies and leading resuscitation.

At a consensus conference in May 2013, "National Maternal Health Initiative: Strategies to Improve Maternal Health and Safety," the Council on Patient Safety in Women's Health Care was assigned to oversee and track the implementation of these bundles nationwide. The conference was attended by more than 30 organizations, including the Society for Obstetric Anesthesia and Perinatology (SOAP). The goal is for every birthing center across the United States to institute these first 3 safety bundles within 3 years [23••].

Hypertensive Disorders of Pregnancy

Hypertensive disorders are the most common disease of pregnancy, with preeclampsia affecting 3.8 % of all pregnancies in the United States, and the relative rate of severe preeclampsia increasing by 322 % from 1980 to 2010 [25, 26]. For patients with severe range blood pressures, anesthesiologists offer expertise in both pharmacologic and technical managements of blood pressure. The American College of Obstetricians and Gynecologists (ACOG) recommends emergent consultation with an anesthesiologist, maternal fetal medicine subspecialist, or critical care specialist to discuss second-line intervention (nicardipine, labetalol, or nitroprusside infusions) when first line treatment has failed [27]. Anesthesiologists provide additional support regarding hemodynamic goals, fluid management, and invasive monitoring (e.g., arterial line placement and intrapartum monitoring). Neuraxial techniques continue to be strongly recommended for preeclamptic women requiring labor analgesia, as well as for surgical anesthesia for cesarean delivery [27]. Epidural analgesia increases uterine blood flow and improves placental blood flow; this effect is even more pronounced in preeclamptic women compared to normal pregnant women [28]. Epidural analgesia also improves maternal blood pressures during painful contractions and avoids general anesthesia if cesarean delivery is required [28].

Obstetric Hemorrhage

Obstetric anesthesiologists play a primary role in identification of early warning signs and estimation of hemorrhage. While obstetricians directly observe blood loss, they may be unaware of the extent of hemorrhage. All providers, including obstetric and anesthesia residents and attendings, as well as nurses, have been shown to underestimate blood loss by as much as 40 % during times of hemorrhage [29]. Simulated massive maternal hemorrhage reveals that clinicians underestimate blood loss on average by 38 % by visual inspection of the field [30]. In addition, the underestimation increases as blood loss increases [30]. Improved accuracy of blood loss estimation through live and web-based education training decreased this underestimation to 4 %; however, the improvement in blood estimation skills disappeared almost completely by 9 months after training [31, 32]. Regular interdisciplinary simulation is necessary to reinforce the skills required for leading and managing obstetric emergencies.

Obstetric anesthesiologists are using simulation to learn and practice skills in leading the management of scenarios involving maternal hemorrhage and other obstetric emergencies including eclampsia, failed intubation, and cardiac arrest [33, 34]. Studies have shown significant deficits in the management of maternal cardiopulmonary resuscitation and failed intubation scenarios among obstetric and obstetric anesthesia providers, with dramatic improvement in education and clinical skills and a reduction in medical errors after simulation training [33, 35].

As the rate of cesarean delivery increases, the incidence of placenta accreta has risen to 3 in 1,000 deliveries during the past decade [36•]. Abnormal placentation is a major cause of PPH with a maternal mortality rate as high as 6–7 % [36•]. A multidisciplinary team approach to caring for patients with abnormal placentation has been shown to improve maternal outcomes [29, 36•, 37]. A recent study compared maternal morbidity in such patients treated with and without a standardized multidisciplinary approach. Instituting a comprehensive multidisciplinary plan was associated with improved maternal outcome, a decrease in the need for emergency surgery and a reduction in estimated blood loss, particularly in cases with more aggressive placental invasion [36•]. Obstetric anesthesiologists are crucial members of this multidisciplinary team and are often the physicians who coordinate communication among the obstetricians and surgeons from other specialties including urology, trauma, vascular surgery, cardiac surgery, and interventional radiology. In addition, anesthesiologists are usually responsible for coordination with the blood bank in implementing massive transfusion protocols.

Postpartum Management of High-Risk Patients

During 1998–2009, severe postpartum complications increased by 114 %, and overall mortality increased by 66 % according to the United States Nationwide Inpatient Sample of 597,920 women with severe maternal morbidity

[6]. An examination of the Maryland State Inpatient Database found that approximately 0.4 % of pregnancies were complicated by intensive care unit (ICU) admission and that ICU utilization most commonly occurred during delivery admission (48.3 %) [7]. Hypertensive disorders of pregnancy, hemorrhage, cardiomyopathy, and other cardiac disease were the most frequent diagnoses [7].

The post-anesthesia care unit (PACU) may be an alternative setting in which high-risk patients can be monitored postpartum, where an anesthesiologist is immediately available for acute care. One university hospital designated a section of the general PACU for high-risk obstetric patients in the immediate postpartum period [38•]. High-risk obstetric patients were identified by the clinical director and senior obstetric anesthesiologist for observation in the PACU. Nursing staff was familiar with both intensive care and obstetric management. Over a 4-year period, 1.53 % of women who gave birth were transferred to PACU, with the mean length of stay in the PACU being less than 24 h. None of the patients required transfer to the ICU, and no maternal mortalities occurred [38•]. The leading cause for PACU observation was postpartum hemorrhage, followed by cardiovascular disorders and preeclampsia.

Ultrasound in the Peripartum Period

The use of ultrasound in obstetric anesthesia continues to expand as technology advances and clinicians discover new applications for its use in pregnant women. Historically, cardiologists and radiologists interpreted ultrasound imaging, and training for image acquisition and interpretation of comprehensive examinations was extensive. Improved technology and a reduction in equipment size and price have allowed ultrasound to be performed at the bedside, thus enabling anesthesiologists to use it as a "point-of-care" modality [39••]. Ultrasound is already used by obstetricians to assess the fetus and placenta in the antepartum and intrapartum periods. Obstetric anesthesiologists have expanded its application to identification of lumbar anatomy prior to neuraxial techniques, focused transthoracic echocardiography examinations to guide diagnosis of and therapy for hemodynamic instability, gastric ultrasound for assessment of aspiration risk, and peripheral extremity ultrasound to obtain intravenous access.

Lumbar Spine Ultrasound

Ultrasound of the lumbar spine has shown promising results regarding improving neuraxial anesthesia techniques [40]. Studies report a decrease in number of attempts [41, 42], in procedure time [42], and in the number of labor epidural replacements [41]. Correlation between estimated depth to epidural space using ultrasound and actual depth in both non-obese and obese parturients has been reported [43–46]. A meta-analysis of 14 randomized controlled trials in which lumbar ultrasound was used for lumbar puncture, spinal anesthesia, combined spinal-epidural (CSE) anesthesia, or epidural placement in obstetric and non-obstetric patients concluded that the risk of failed procedures was reduced by 0.21 (95 % confidence interval 0.10 to 0.43, $p < 0.001$) [46]. Absolute risk reduction was 0.063; the number needed to treat to reduce one failure was 16 ultrasound-assisted procedures [46].

Pre-procedure ultrasound examination is done to identify midline, lumbar interspace levels, and subsequently the optimal needle insertion point on the skin [47]. The depth to the epidural space is also measured. The skin is marked, and epidural or spinal placement is done using a standard technique. Examinations are generally done prior to sterilization of the skin and draping in order to avoid any possibility of contaminating the sterile field. Advantages to ultrasound include that it is noninvasive, mobile between labor rooms and operating rooms, and the probe can be easily cleaned with a sterile wipe between patients.

Although a skilled anesthesiologist may perform neuraxial techniques quickly, pre-procedure ultrasound may be advantageous for patients with an increased risk for difficult epidural placement, including previous spine surgery or scoliosis, morbid obesity, or difficult to palpate landmarks [47, 48]. In addition, the vertebral level predicted by anesthesiologists for pregnant women by landmark palpation may be at least one level higher than the anatomical position identified by ultrasound 40 % of the time [49], and can be up to 3–4 levels higher [49–51]. Furthermore, the conus medullaris can lie below L1-2 [52], and spinal cord injury after neuraxial techniques in parturients has occurred [53]. Anesthesiologists using ultrasound to correctly identify L3-4 and L4-5 interspaces prior to neuraxial techniques may improve patient safety.

Although uncommonly utilized, real-time ultrasound-guided placement of CSE has been successful for parturients undergoing elective cesarean delivery [54, 55]. Two-operator guidance, in which one operator holds the ultrasound probe while the other advances the epidural needle, has been reported to significantly reduce the number of attempts compared to landmark palpation [54]. CSE was obtained with one needle pass in all 10 patients in the ultrasound group, while 6/10 patients in the landmark palpation group required more than one attempt ($p < 0.036$) [54]. During single-operator guidance for CSE, in which epidural needle advancement was done with a needle guide mounted on the ultrasound probe, loss of resistance was obtained in 18/19 patients and aspiration of cerebral spinal fluid in 14/18 patients [55]. Echogenic

epidural needles may improve needle tip visibility, needle image quality, and operator comfort [56].

Ultrasound image processing may also increase the safety of neuraxial anesthesia in the future. The ultrasound images are video streamed, and algorithms are then used to process the images and to automatically recognize structures (articular process, vertebral body, and epidural space). Thus, the optimal needle insertion site can be identified [57, 58]. This program may be useful in correctly identifying interspaces from ultrasound images in which anatomy is difficult to recognize visually.

Transthoracic Echocardiography

Transthoracic echocardiography (TTE) is rapidly becoming a point-of-care tool used by emergency room physicians, critical care physicians, and anesthesiologists [1, 59], and may become an important tool in evaluating obstetric patients. Advantages include it being noninvasive, readily available, mobile (can be used in the holding area, labor rooms, operating rooms, and recovery room), and acceptable for pregnant women. For laboring patients or those requiring urgent cesarean delivery, technologists and cardiologists may not be immediately available, especially overnight or on weekends.

Although cardiologists and other professionals may be trained in comprehensive echocardiography examination and interpretation, in emergency situations, obstetric anesthesiologists may use pattern recognition for a restricted group of diagnoses in conjunction with the clinical details to narrow a differential diagnosis and guide therapy [39••, 60]. Alternative diagnoses can be made and confirmed. The effects of interventions, such as administration of fluids or vasopressors, can be immediately evaluated. In one study of patients having emergency noncardiac surgery, preoperative goal-focused TTE examinations done by an anesthesiologist trained in HEART (Haemodynamic Echocardiography Assessment in Real Time) directed management decisions (fluid bolus, vasopressor infusion, central venous catheter placement, and delay in surgery for cardiology referral) in 44 % of 99 patients [61]. Currently, several goal-focused TTE examination protocols are available, and have been developed for the purpose of rapid assessment, generally in less than 10 min [39••, 60].

A focused TTE exam for obstetric patients, rapid obstetric screening echocardiography (ROSE), has been recently developed [1] and emphasizes the use of the parasternal and apical views (more easily obtained than other views for pregnant women) for rapid assessment of contractility, volume status, and right heart function and relative size. Diagnosis and management of hemorrhage, unexplained hypotension, sepsis, preeclampsia, embolism, and cardiac arrest can be done. These leading causes of maternal mortality [62] can be recognized and managed quickly and early by anesthesiologists at the bedside. Future prospective studies are needed to measure the clinical impact of goal-directed focused TTE in the peripartum period.

Training courses have been developed for perioperative physicians and have shown that anesthesiologists and anesthesia residents can obtain skills in both image acquisition and interpretation through the use of didactics, workshops, and hands-on training [63–66]. Hand-carried ultrasound systems are [39••, 65], and low-frequency phased array probes are compatible with ultrasound machines used for central line placement.

Gastric Ultrasound

Aspiration during general anesthesia for cesarean delivery continues to be a serious risk for parturients [67]. In addition, even postpartum patients may have delayed gastric emptying of solid food [68]. Currently, the Practice Guidelines for Obstetric Anesthesia recommend that women for elective cesarean delivery follow the same fasting guidelines as for nonpregnant patients requiring surgery (2 h for clear liquids, 6–8 h for solids), and uncomplicated patients may consume modest amounts of clear liquids during labor [69]. The use of gastric ultrasound may assist clinical decision-making regarding the timing of unscheduled non-emergent cesarean deliveries, as well as the need for H2 blockers, proton pump inhibitors, or prokinetic medications to augment gastric emptying.

Both qualitative assessments of gastric content and quantitative assessments of gastric volume have been described in obstetric and non-obstetric patients [70, 71, 72•, 73, 74]. The scan is done with the patient in the supine and right lateral decubitus positions, both with 45° head elevation [71]. A low-frequency 2–5 MHz curvilinear array probe is used in the sagittal and axial planes to examine the antrum. The empty stomach is identified as a "bull's eye" target, liquid is identified as a "starry night" appearance, and solid food has a "frosted glass" appearance [72•]. Stomach volume is calculated using the antral cross-sectional area (either by measuring two perpendicular diameters of the antrum or by free tracing the outer layer of the gastric wall) [73].

Both methods for measuring cross-sectional area were reported to have excellent intrarater and interrater reliability for anesthesiologists performing examinations on healthy, nonpregnant patients [73]. Ultrasonographers included a certified ultrasonographer, an anesthesiologist with >500 gastric scans, and an anesthesia fellow with >50 scans. Interrater reliability intraclass correlation coefficients were

0.96 (95 % CI 0.91–0.98) for the two-diameter calculation method and 0.96 (95 % CI 0.92–0.98) for the free-tracing calculation method. Intrarater reliabilities had intraclass correlation coefficients of 0.97 (95 % CI 0.94–0.99), 0.98 (95 % CI 0.95–0.99), and 0.96 (95 % CI 0.91–0.98), respectively, with the two-diameter method and 0.97 (95 % CI 0.94–0.99), 0.99 (95 % CI 0.97–0.99), and 0.96 (95 % CI 0.90–0.98), respectively, with the free-tracing method [73].

In pregnant patients, a recent study reports good interrater reliability for qualitative assessment of gastric contents [71]. The 3 ultrasonographers were anesthesiologists trained in qualitative assessment of gastric content using ultrasound in male volunteers and one year of experience using the technique. Thirty-two pregnant, non-laboring women at ≥32 weeks gestational age were randomized to fasting, ingestion of clear fluids, or ingestion of solid food [71]. Interrater reliability was a kappa statistic of 0.74 (95 % CI 0.68–0.84), indicating substantial agreement. The average number of cases required for an anesthesiologist to achieve 95 % success in differentiating an empty stomach versus liquid versus solid food is 33 examinations after an educational program including reading material, a video, an image library, a lecture, and a workshop [74].

Intravenous Access

Although many obstetric patients are healthy and peripheral intravenous access may be obtained quickly and easily, for other high-risk patients with preeclampsia, obesity, diabetes, renal insufficiency, or sickle cell disease, this task may be a considerable challenge. All laboring women and women presenting for cesarean delivery benefit from large bore intravenous (IV) access of at least 18 gage, and obstetricians rely on anesthesiologists when access cannot be established by nurses. The same high-frequency linear array probe that is used for placement of central venous access can be used for in-plane (longitudinal view of the vein) and out-of-plane (cross-sectional view of the vein) techniques for peripheral vascular access [75]. Use of ultrasound is reported to improve success rates [76, 77], decrease the time for intravenous catheter placement, and improve patient satisfaction [76]. One study reports that use of ultrasound by emergency room physicians on patients for which IV access was difficult to obtain using a traditional landmark approach decreased the total time to successful IV placement to 4 min from 15 min (95 % CI 8.2–19.4) with fewer attempts (1.7 versus 3.7, 95 % CI 1.27–2.82) [76]. Success rate was 97 % for the ultrasound group and 33 % for the traditional landmark approach [76]. Patients in the ultrasound group had greater satisfaction using a Likert scale (8.7 versus 5.7, 95 % CI 1.82–4.29) [76]. Finally, anesthesiologists are able to place central lines in parturients if peripheral access still cannot be obtained.

Postpartum Pain Management

Obstetric anesthesiologists have a significant influence on the effects of postpartum pain immediately postoperative and long term. A survey in 2005 revealed that among anesthetic concerns, including postoperative nausea and vomiting (PONV), shivering, and pruritus, parturients were most concerned about pain during and after cesarean delivery [78]. The goal of postpartum pain management is to reduce total opioid consumption and its side effects, and to facilitate early ambulation and interaction with the newborn [79]. The efficacy of neuraxial opioids for post cesarean delivery pain is well documented in the literature [80–82], and its use with multimodal analgesia consisting of non-opioid medications, including paracetamol, NSAIDs, and COX-2 inhibitors, has been shown to further reduce the amount of morphine consumed postoperatively [79, 83–87]. No clear difference, however, has been demonstrated between these adjuncts [85]. For patients who have contraindications to neuraxial morphine or NSAIDs, anesthesiologists can also provide postoperative analgesia by performing transversus abdominis plane (TAP) blocks in the recovery room.

Transversus Abdominis Plane Block

Ultrasound-guided transversus abdominis plane (TAP) block can be done in addition to, or in lieu of, neuraxial morphine or oral and intravenous analgesics. Although TAP blocks have not been shown to be more effective than intrathecal morphine with multimodal analgesia in reducing post cesarean opioid consumption and pain scores [88, 89], there are some early effects with high-dose blocks. One study compared high-dose ropivacaine (3 mg/kg), low-dose ropivacaine (1.5 mg/kg), and placebo TAP block in addition to multimodal analgesia including intrathecal morphine. At 24 h postoperatively, there were no differences between treatment groups in pain scores with movement at 24 h (the primary outcome) or for time to first request for additional analgesia and total consumption of opioids [90•]. A statistically significant reduction in pain with movement occurred in the high-dose group at 6 and 12 h postoperatively (secondary outcomes) [90•]. In addition, no differences have been found in the incidence of PONV, pruritus, urinary retention, or health quality and physical functioning reports at 30 days and 6 months postoperatively (as indices of chronic pain) [91].

Moreover, slightly higher pain scores have been reported at 24 and 48 h in patients receiving TAP blocks [91]. Authors suggest that this may be due to rebound pain [92,

93]. Ultimately, TAP blocks may reduce or delay opioid use during the first 2–24 h postoperatively, after which patients may require greater opioid consumption to compensate for the transient hyperalgesia experienced during block regression [91]. Further studies explaining the physiology of rebound pain may allow for this modality to be used more frequently in the future.

Conclusion

The complexities of parturient comorbidities compel anesthesiologists to assume an active role in the management of high-risk antepartum, laboring, and postpartum patients. Patient care requiring invasive procedures, resuscitation, and crisis management can occur in any of these settings, and optimal communication with obstetricians allows for anesthesiologists to be involved early. Improving maternal morbidity and mortality is the greatest challenge facing the obstetric team today, and obstetric anesthesiologists establishing their role in perioperative care allow for their skills and expertise to positively affect maternal and fetal outcomes.

Compliance with Ethics Guidelines

Conflict of Interest Daria M. Moaveni, Jennifer H. Cohn, Zahira D. Zahid, and J. Sudharma Ranasinghe declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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- • Of importance
- •• Of major importance

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