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40 Years of Progress in Obstetric Anesthesia Safety: Milestones, Challenges, and Future Directions

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INTRODUCTION

Anesthesiology has emerged as a leader in patient safety through innovations in monitoring, education, and simulation, and a willingness to look introspectively at human factors in critical events. This is evident in obstetric anesthesiology, where the latter half of the last century saw a significant reduction in anesthesia-related maternal mortality and anesthesia-related complications.[1] Publication of guidelines for best practice and standards of excellence in obstetric anesthesiology continue to advance the specialty with respect to patient safety.[2] However, maternal mortality remains a leading cause of death in women aged 20–44 years, and although the rising rate of maternal mortality in the United States has leveled in recent years, it continues to rank the worst of any high resource country on this metric.[3] Anesthesia-related complications are now the least common cause of maternal mortality according to the Pregnancy Mortality Surveillance System, but emerging issues such as patient complexity and workforce demands, and persistent challenges including racial and socioeconomic disparities, still pose a threat to maternal safety.[4] There continue to be opportunities for anesthesia professionals to leverage expertise in acute care medicine, maternal physiology, and principles of patient safety to help address other causes of maternal morbidity and mortality. To mark the *APSF Newsletter's* 40th anniversary, this article provides a retrospective on four decades of progress in obstetric anesthesiology, explores ongoing challenges, and looks ahead to future directions in patient safety.

MILESTONES

Anesthesia-related maternal mortality decreased significantly with the shift away from general anesthesia and toward neuraxial analgesia and anesthesia over the last 40 years.[1] Much of the improvement in anesthesia outcomes can be attributed to advances in neuraxial anesthesia safety. Modern labor analgesia has moved toward lower-dose local anesthetic concentrations and lower total local anesthetic consumption, reducing the risk of high neuraxial block, local anesthetic toxicity, and operative vaginal delivery.[5,6] The introduction of noncutting needles allowed for the widespread use of subarachnoid block for surgical anesthesia, while reducing the likelihood of postdural puncture headache, failed regional anesthesia, and local anesthetic exposure.[2] Research into the optimal vasopressor to mitigate spinal-induced hypotension and utilizing the lowest effective opioid dose to enhance postpartum analgesia have minimized the adverse effects of neuraxial anesthesia for mother and baby.[7,8] Use of neuraxial anesthesia in patients has been shown to reduce severe maternal morbidity.[2,9] Subspecialty training in obstetric anesthesiology has been shown to reduce the use of general anesthesia for cesarean delivery, which may further reduce maternal morbidity.[10] That said, neuraxial anesthesia is not without risk. High neuraxial block and bradyarrhythmia associated with spinal anesthesia are leading causes of maternal cardiac arrest, and the increased presence of tranexamic acid on labor and delivery floors following the Woman Maternal Antifibrinolytic Trial (WOMAN), has led to rare but catastrophic medication errors.[11,12]

Once a leading cause of anesthesia-related maternal mortality, fatalities from aspiration and failed airway management have declined to very low levels. Expanded access to videolaryngoscopy, use of aspiration prophylaxis, publication of difficult airway algorithms, and incorporation of obstetric-specific recommendations in airway guidelines have improved the safety of general anesthesia for pregnant patients.[13] Taken together, these changes to neuraxial and general anesthesia have resulted in remarkably safe anesthesia and analgesia for childbirth.[14]

Obstetric anesthesiology as a specialty has also had a key role in addressing nonanesthetic causes of maternal morbidity and mortality. Anesthesia professionals are instrumental to the implementation of maternal early warning systems and the recognition and management of the main contributors to maternal morbidity and mortality, including hemorrhage, hypertensive crisis, sepsis, venous thromboembolism, and heart failure.[15] Care bundles to address these complications have been developed by multiple groups, including the Alliance for Innovation on Maternal Health and the California Maternal Quality Care Collaborative, and have been shown to be cost-effective in reducing severe maternal morbidity.[16] Even in low resource settings, protocolized care for postpartum hemorrhage has repeatedly been associated with improved outcomes.[17] Specifically for hemorrhage and hypertensive disorders, the care bundles identify anesthesia professionals as active participants in the multidisciplinary protocolized care of these patients to improve outcomes.[3]

Interdisciplinary communication and coordination are features of high-reliability organizations, and preoperative and pre-procedural checklists and huddles have been found to facilitate effective teaming on labor and delivery units.[18] Debriefings following critical events

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and reporting and reviewing patient safety concerns through peer-protected Quality Assurance committees allow for mutual learning and the opportunity to address system-level safety challenges, and provide support to the potential "second victims" of critical events.[19] Increased use of simulation as a means to practice recognizing and managing peripartum emergencies has also helped bolster a culture of safety and has been shown to improve multidisciplinary team performance.[20]

CHALLENGES

Emerging and persistent challenges to maternal safety include increasing patient complexity, maternal mental health conditions, racial disparities in outcomes, and geographic and socioeconomic barriers to care. The risk profile of the birthing population is changing, with an increasing prevalence of chronic diseases. There is a dose-dependent relationship between the number of maternal comorbidities and risk of severe morbidity.[21] A useful tool in risk stratification is the Obstetric Comorbidity Index (OB-CMI), a validated, numerical scoring system that uses maternal comorbidities to assess and predict the risk of severe maternal morbidity and mortality. Such targeted surveillance, ensuring risk-appropriate levels of maternal care, and the expanded role of the anesthesia professional as a perinatal consultant are tactics for improved maternal outcomes.[3] Antenatal planning and optimization is a core component of obstetric anesthesiology, but over half of pregnancy-related deaths occur between 7 and 365 days postpartum.[22] Experience in perioperative medicine means that the anesthesia professional is also well positioned to recognize patients at high risk for postpartum decompensation and escalate their care to the appropriate level with respect to scope and acuity. Team-based care should not end at delivery, and anesthesia professionals can meaningfully contribute to postpartum disposition planning.

Maternal mental health conditions, including suicide, and overdose or poisoning related to substance use disorder, are now leading causes of maternal mortality, along with hemorrhage, cardiac and coronary conditions, infection, thrombotic embolism, and cardiomyopathy.[22]

Recognizing at-risk patients, implementing trauma-informed care, and addressing pain are important ways that anesthesia professionals can impact morbidity and mortality related to maternal mental health.[23]

Maternal mortality remains unacceptably high among racial and ethnic minority groups, and this trend persists even in countries where maternity care is covered.[24] Black women in the United States experience a substantially higher rate of severe maternal morbidity and are over-represented among maternal deaths.[25] Black women are more likely to die from cardiac and coronary conditions, are less likely to receive care escalation for postpartum hemorrhage, and are less likely to receive an epidural blood patch for postdural puncture headaches.[22,26,27]

Social determinants of health play an ongoing role in maternal morbidity and mortality. Geographic and socioeconomic barriers to care result in low- and middle-income countries experiencing higher rates of preventable maternal deaths.[28] Even within high-income countries, there are barriers to accessing safe and comprehensive reproductive health care. These include legislative barriers in the form of bans or restrictions on abortion care, which disproportionately affect women who may already have difficulty accessing appropriate care due to socioeconomic circumstances.[29] Advocacy, workforce planning, and anesthesia training can help address these inequities in global health care settings.

FUTURE DIRECTIONS

Modernization of anesthesia care, increasing patient complexity, and ongoing challenges in health care inequity highlight the need for new tools in the safety toolkit of the peripartum clinician and a renewed focus on maintaining the standards of care set out by professional asso-

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ciations. Point of care ultrasound is an example of such a tool, which can reduce procedural complications related to neuraxial anesthesia, objectively assess aspiration risk, and aid in the diagnosis and management of cardiopulmonary complications in the unstable patient.[30] Risk predictive tools driven by artificial intelligence (AI), big data models, and biologic markers may offer novel solutions to personalizing risk stratification, coordinating early intervention, and managing scarce resources. Wearable technology represents a new paradigm in postoperative care and at-home monitoring may provide an avenue for addressing a component of postpartum morbidity and mortality.[31] Implementation of consensus-based standardized care, such as enhanced recovery after cesarean delivery (ERAC) protocols, may help to address racial disparities and continue to advance the specialty from the perspective of patient safety and quality care.[32]

CONCLUSION

The majority of pregnancy-related deaths continues to be preventable, indicating ongoing barriers to care and safety concerns in obstetric anesthesia. For every maternal death, there are 70 to 80 cases of severe morbidity at the time of hospitalization, and this definition does not include morbidity in the prenatal or postpartum periods.[33] Reflecting on the last 40 years in obstetric anesthesia highlights the progress that has been made in anesthesia-related patient outcomes, but also underscores how far we have yet to go in advancing maternal care for all women. Anesthesia professionals can play an important role in addressing the impact of hemorrhage, hypertensive disorders, and other threats to maternal well-being by utilizing clinical expertise and evidence-based protocols to provide timely care, at an appropriate level of acuity, and with safe interventions. We can continue to encourage the use of neuraxial anesthesia where possible, and have a more nuanced approach to patient selection and safety for general anesthesia. Adhering to standards of best practice, leveraging new technologies in obstetrics and anesthesia, and continuing to foster a culture of safety can help to ensure continued forward progress.

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