Review Article

Maternal Care Under Pressure: Providing Obstetric Anesthesia During Disasters and Low-Resource Settings

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Abstract

This article is a narrative review of obstetric anesthesia in low-resource and disaster-affected settings, employing a comprehensive synthesis of experiences from natural disasters and low- and middle-income countries. The methodology involved a search of recent literature and organizational guidelines to identify challenges, ethical dilemmas, and strategic approaches. The review categorizes deficiencies in infrastructure, workforce, and equipment, examining feasible anesthesia and analgesia techniques during crises and outlining ethical considerations relevant to resource allocation and triage. Disaster conditions frequently result in loss of electricity, oxygen supplies, monitoring equipment, sterile facilities, and trained personnel. Spinal anesthesia remains the preferred technique for cesarean section, while ketamine-based total intravenous anesthesia provides a safe alternative when monitoring is limited. Epidural analgesia may be unavailable, necessitating reliance on systemic or non-pharmacologic pain management strategies. Early risk triage, simplified protocols, and multidisciplinary teamwork are essential for safe care. Strategies such as simulation training, telemedicine supervision, and resilient infrastructure can mitigate risks, but ethical dilemmas—such as prioritizing high-risk patients and resource allocation—must be addressed within predefined frameworks. Overall, obstetric anesthesia in these settings requires adaptability, preparedness, and ethical awareness. Through context-specific protocols, task shifting, and interprofessional collaboration, anesthesiologists can sustain safety and improve maternal and neonatal outcomes despite severe constraints. Strengthening disaster readiness and resilience within maternity anesthesia services is increasingly vital in light of global instability.

Keywords: obstetric anesthesia; disaster; low-resource setting

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1 Introduction

Obstetric care represents one of the most critical components of urgent medical services. In high-income settings, the vast majority of births occur within controlled and monitored hospital environments. However, in the context of global sociopolitical instability, mass migration, climate-driven disasters or war, those hospital settings may become inaccessible, destabilized or inadequate, even in developed countries. We conducted a search of the literature by entering keywords "obstetric anesthesia", "disaster" and "low-resource setting", using databases PubMed and Google Scholar to identify relevant articles on the topic.

Recent reports from World Health Organisation (WHO), United Nations Population Fund (UNFPA), and Médecins Sans Frontières (MSF) emphasize that pregnant women in contexts of low-resource settings and disasters face elevated peripartal risks (1-3). In the face of increasingly unpredictable global events, it is prudent to engage in a broad discussion about how to prepare for urgent obstetric and anesthesia care for pregnant women in low-resource and disaster-affected settings.

Under such stressful conditions, pregnant women face elevated risks of complications, such as premature birth, low birth weight, neonatal death and maternal morbidity. In scenarios of staff shortages, equipment failures and inadequate infrastructure, anesthesiologist must be prepared to triage and prioritise pregnant women at higher risk: those with pre-eclampsia, heart disease, risk of massive postpartum hemorrhage or difficult airway requiring emergency cesarean section. Elective surgical procedures should be deferred when possible. During disaster settings, there is a high likelihood of shortages or absence of critical equipment and infrastructure (e.g. electricity, central gas supply, sterile operating theatres, etc.) and of having to provide care in non-standard spaces such as delivery rooms or improvised operating areas.

Past disasters have illustrated these vulnerabilities. For example, during Hurricane Katrina in 2005 and Hurricane Harvey in 2017, elective procedures were postponed, staff and patients were transferred to suboptimal environments and functioning operating theatres often depended on emergency generator power (4,5). In Croatia, the 2020 earthquakes in Zagreb and Petrinja exposed the fragility and unpreparedness of the public healthcare system and crisis services to handle such unexpected events. The aim of this article is to raise awareness of obstetric anesthesia in disasters and low-resource settings and to explore practical approaches for labour analgesia, anesthesia for cesarean section and management of life-threatening obstetric conditions in these contexts.

2 Infrastructure, Workforce, and Equipment Challenges

In disaster or low-resource environments, fundamental infrastructure may fail or be absent. Essential deficiencies include: unreliable electricity, interrupted oxygen or gas pipelines, lack of running water and sterilisation services, inadequate theatre ventilation and lack of sterile supply chains. Access to essential drugs (e.g., local anesthetics, opioids, uterotonics, etc.) and

consumables (suction tubing, oxygen cylinders, sterile kits) may be disrupted. The literature from low-income and middle-income countries shows that safe obstetric anesthesia is strongly constrained by such infrastructure and equipment gaps. For instance, a cross-sectional survey in East Africa found that facilities providing obstetric anesthesia often lacked adequate monitoring, equipment and staffing (6). These deficits are magnified during disasters when back-up systems may collapse.

Workforce shortages are another major barrier: trained obstetric anesthesiologists may be depleted, evacuated or overwhelmed, leading to reliance on nurse-anesthetists or general practitioners with limited obstetric experience. Burnout and moral stress are frequent under high patient loads and uncertain working conditions. Adequate planning must include minimal staffing benchmarks, cross training of non-specialist providers, mental-health support for staff and clear protocols for supervision.

Equipment and monitoring deficiencies undermine safe care: absence of pulse oximetry, non-functional ventilators, lack of safe blood supplies, limited infection-control capacity and unreliable laboratories. International literature emphasises that safe obstetric anesthesia requires at minimum a functional monitor, essential airway equipment, reliable drugs and a trained provider. In a disaster settings, anesthesia team must anticipate that standard monitoring may be unavailable and adapt accordingly by employing simplified protocols and conservative safety margins. Communication and logistics challenges further complicate care: supply-chain disruption, referral pathway breakdowns, evacuation or transport difficulties, and communication system failures. The so-called "third delay"—delay in receiving adequate care at a facility—is magnified in these contexts. As seen during major hurricanes, hospitals far from the disaster zone experienced patient surges and logistic stress. Obstetric teams must plan referral and transport contingencies, coordinate with obstetric, neonatal and surgical teams, and have fallback protocols when standard infrastructure fails (7-10).

3 Labour Analgesia

In resource-rich settings, lumbar epidural analgesia is administered in 10-64% of deliveries and is recommended by the WHO as the gold standard for labour pain management (11). However, in unexpected and low-resource settings following natural or socio-political disasters, the provision of epidural analgesia may be delayed or impossible due to staffing, monitoring or supply constraints. Because labour analgesia is elective and not life-saving per se, it may be de-prioritised. In such situations, clear communication with the parturient during active labour is essential. Alternative pharmacologic (e.g., parenteral meperidine or tramadol) and non-pharmacologic techniques (continuous support, breathing techniques, mobilisation) must be considered, as well as dependance on non-trained medical staff, or even non-medical staff to provide support for women in labour.

4 Anesthesia for Cesarean Section

Pregnant women carry increased risk during general anesthesia, such as difficult airway, increased aspiration risk, anaphylaxis, etc. As a result, general anesthesia for cesarean section should be avoided unless regional techniques (spinal, epidural, combined spinal-epidural) are contraindicated or in immediate life-threat emergencies (umbilical cord prolapse, placenta previa with active bleeding, placental abruption, eclampsia, failed instrumental vaginal delivery, etc.) (12,13). In such situations, effective communication between the anesthesiologist and obstetrician is critical, but during disaster settings, human factors (stress, fatigue, compromised team cohesion) may hamper this.

Spinal anesthesia remains the gold-standard technique for cesarean section. Epidural anesthesia may follow a vaginal delivery attempt if a lumbar epidural catheter is already in place. In settings where central neuraxial block or general anesthesia is impossible, local anesthetic infiltration for cesarean section is documented in the literature (14,15). The use of a transversus abdominis plane (TAP) block as the primary anesthetic for laparotomy/cesarean has also been reported (16). In the context of regional anesthesia techniques, a project conducted from 2020 to 2023 is worth mentioning, since it showed that introduction of regional anesthesia techniques (such as transversus abdominis plane blocks) via virtual and in-person training in a rural Tanzanian hospital led to significant reductions in post-cesarean pain scores and opioid use (17).

In severely resource-limited settings, intravenous ketamine may serve as an alternative. Ketamine induces dissociative anesthesia, has intrinsic analgesic effect, preserves respiratory drive and stimulates cardiovascular function, and thus requires less extensive monitoring (18,19). In a 2022 study of 401 parturients undergoing emergent cesarean section in a low-resource environment, ketamine-based total intravenous anesthesia proved as safe with no maternal deaths (18).

5 Lack of Blood Products and Diagnostic Capabilities

Postpartum hemorrhage (PPH) remains the leading cause of maternal mortality globally (20). International classification divides PPH into three categories:

- Postpartum hemorrhage: blood loss greater than 500 mL within 24 hours of delivery
- Severe postpartum hemorrhage: blood loss greater than 1000 mL within 24 hours of delivery with symptoms of hypovolemia
- Massive, life-threatening hemorrhage: blood loss greater than 2500 mL within 24 hours of delivery or hemorrhage leading to hypovolemic shock

Continuous and increasing trends, such as older maternal age, obesity, multiple pregnancies, medically assisted reproduction, macrosomia, labor induction, as well as rising rates of cesarean section as a mode of delivery, have increased incidence of PPH incidence and related transfusion

needs (21-23). During disaster or low-resource settings, critical vulnerability of patient blood management concept in obstetrics lies in blood product supply, diagnostic capacity, and safe transfusion infrastructure.

In resource-poor/disaster environments, blood product shortage is a major risk factor. Therefore, high-risk women must be identified early, communication with blood banks or mobile transfusion services must be arranged, and pharmacologic (uterotonics, tranexamic acid) and non-pharmacologic measures should be applied. Prophylactic use of tranexamic acid in high-risk women merits emphasis (24,25). Regarding obstetric diagnostics in resource limited setting: although the American Society of Anesthesiologists guidelines note that platelet count is not necessary in healthy women before neuraxial anesthesia and/or analgesia, the decision remains the anesthesiologist's, especially when diagnostics are unavailable (26). It is to mention that gestational thrombocytopenia (platelet count less than 150×10^9/L) occurs in uncomplicated pregnancies. However, values below 100×10^9/L are rare (<1%) and the 2021 consensus from the Society for Obstetric Anesthesia and Perinatology states that the risk of spinal/epidural hematoma is very low at platelet counts above 70×10^9/L (27,28). Given variable institutional and individual practices, in situations with limited diagnostics, the decision must be clinically driven and conservative.

6 Ethical and Strategic Considerations in Low-Resource Obstetric Anesthesia

Disaster settings inevitably raise ethical dilemmas: which pregnant women should be prioritised? Should women with lower risk labor analgesia wait while resources are devoted to higher risk cases? How should the team balance maternal versus neonatal risk when monitoring is minimal? Who decides when to proceed with cesarean section under suboptimal conditions? The moral burden of allocating scarce monitoring, blood products, operating theatre time and staff falls heavily on providers. Advanced triage frameworks and mental-health support for staff are essential. Recent reports from relevant organisations, such as WHO and UNFPA, showed that maternal and neonatal outcomes in low- and middle-income countries still remain poor, despite gradual improvement over the years: the global maternal mortality ratio has declined from 339 to 223 deaths per 100,000 live births during the period 2000 to 2020, an annual reduction of 2.1% per year (1,2).

Historically, anesthesiologists have been urged to train for mass casualty incidents and disaster response-specific roles. Strategic preparedness thus encompasses not only technical protocols but also ethical guidance, provider well-being, and institutional governance in crisis (10,29-31).

7 Proposed Solutions and Context-Appropriate Strategies

Given the constraints, several pragmatic strategies can mitigate risk and enhance safety:

- **Low-tech resilient anesthesia techniques**: Prioritize regional over general anesthesia when feasible. Spinal anaesthesia for cesarean section is the method of choice in the absence of contraindications (10). Use ketamine based total intravenous anesthesia in settings where monitoring is minimal (18,19).
- **Training, task shifting and simulation**: Empower midwives, general practitioners and nurse anesthetists with standardized training and protocols for maternity anesthesia and obstetric crises. Courses like three day Safer Anaesthesia from Education (SAFE) in Tanzania demonstrated sustained improvements in practice metrics (32). Simulation of obstetric hemorrhage, difficult airway and regional anesthesia under minimal resource conditions should be incorporated into disaster drills.
- **Simplified checklists and protocols**: Develop checklists adapted for low resource/disaster maternity anesthesia (e.g. minimum monitoring: pulse oximeter and non-invasive blood pressure; emergency airway kit; uterotonics kit, etc.). Standardisation reduces variation and error.
- **Telemedicine and remote supervision**: Where infrastructure permits, remote guidance by specialist anesthesiologists can support less experienced providers in real time, supplement hybrid training, and foster bidirectional knowledge exchange.
- **Multidisciplinary communication and team-based care**: Pre-disaster planning must include obstetricians, anesthesiologists, midwives, neonatologists, nursing and logistics teams. Clear referral pathways, transport plans and evacuation procedures are critical.
- **Infrastructure resilience and supply-chain planning**: Maternity units should maintain backup power, oxygen cylinder reserves, mobile theatres or delivery units, emergency blood-product protocols and rapid resupply agreements.
- **Quality metrics and benchmarking in low-resource settings**: Professional societies should support development of minimum standards for obstetric anesthesia in disaster environments: essential monitoring (at least pulse oximetry), staffing ratios, drugs list, training requirements and outcomes monitoring. Measuring outcomes, even in constrained settings, enables gap identification and improvement.

8 Conclusion

Obstetric anesthesia in a low-resource settings during natural disasters, conflict or mass migration presents unique and pressing set of challenges. With global sociopolitical and climate instability increasing, the imperative to provide safe maternity care under compromised conditions is more relevant than ever. Limited access to essential drugs, equipment, skilled personnel and safe infrastructure can significantly compromise maternal and neonatal safety. Nonetheless, safe

and effective anesthesia and analgesia remain possible through context-appropriate adaptations, simplified evidence-based protocols and robust planning.

In disaster or low-resource maternity environments, the anesthesiologist's role must expand: triage high-risk women, adapt to limited monitoring, support non-specialist providers, and function within pre-defined protocols. Ensuring safe childbirth in extreme conditions requires investment in training, human resource resilience, supply-chain robustness, tele-support, multi-disciplinary teamwork and disaster-specific protocols. With such preparation and by tailoring solutions to context-specific constraints, maternal and neonatal outcomes can be improved in disasters and low-resource settings alike.

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Ethics Statement

This work does not contain any studies with human or animal participants.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

Author Contributions

N.D., K.R., S.M. and M.C. designed the article. K.R. and S.M. searched the literature. N.D., K.R. and M.C. wrote the article. All authors read and approved the final manuscript.

Data Availability

Data sharing is not applicable to this article as no datasets were generated or analysed.

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