

Anaesthesia in Obstetrics: Maternal and Neonatal Outcomes

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Abstract:

Anesthesia plays a crucial role in obstetric care, providing pain relief during labor, facilitating operative deliveries, and managing various obstetric emergencies. This research paper aims to review the impact of anesthesia on maternal and neonatal outcomes in obstetrics. We will discuss the different types of anesthesia used in obstetric practice, including regional and general anesthesia, and evaluate their effects on maternal morbidity, mortality, and neonatal outcomes. The paper will also explore recent advancements in anesthesia techniques and their potential implications for improving obstetric care. By synthesizing existing evidence, this study aims to enhance our understanding of anesthesia's role in optimizing maternal and neonatal outcomes in obstetrics.

Keywords: Anesthesia, Obstetrics, Maternal and Neonatal.

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Introduction

Background:

Childbirth is a remarkable event in a woman's life, accompanied by intense pain and physiological changes. Anesthesia plays a pivotal role in managing pain and providing safe obstetric care, ensuring optimal outcomes [1]. The administration of anesthesia during labor, operative deliveries, and obstetric emergencies requires techniques on maternal and neonatal well-being.

Objective:

The primary is to investigate the impact of anesthesia on maternal and neonatal

outcomes in obstetrics. By reviewing the existing literature and synthesizing the available evidence, this study is to anesthesia techniques employed in obstetric practice and their implications for maternal morbidity, mortality, and neonatal outcomes. Additionally, the paper will explore recent advancements in anesthesia techniques and their potential to improve obstetric care [2].

The outcomes under investigation will include maternal pain relief and satisfaction, maternal morbidity (such as hemodynamic stability, respiratory complications, neurological complications,

risk of infection and postpartum hemorrhage), maternal mortality, fetal well-being, Apgar score, neonatal resuscitation, long-term neurodevelopmental outcomes, and the transfer and effects of medications used for anesthesia.

Understanding the effects of anesthesia on obstetric outcomes is vital for healthcare providers, including obstetricians, anesthesiologists, and involved in providing obstetric care. This knowledge can guide clinical decision-making, enhance patient safety, and improve the overall quality of care delivered to pregnant women and their new-borns. Through this research paper, we aim to contribute to the existing body of knowledge on anesthesia in obstetrics and highlight areas that require further research and development [3]. By doing so, we aspire to promote evidence-based practices and ultimately improve maternal and neonatal outcomes in obstetric anesthesia.

Anesthesia Techniques in Obstetrics:

Regional Anesthesia:

Regional anesthesia techniques are commonly used in obstetrics due to their ability to provide effective pain relief while minimizing the risks associated with general anesthesia [4]. The two primary regional anesthesia techniques employed in obstetric practice are epidural analgesia and spinal anesthesia.

Combined Spinal-Epidural Analgesia:

Combined spinal-epidural (CSE) analgesia combines the advantages of both spinal and epidural anesthesia techniques. It involves the initial administration of a small dose of local anesthetic and/or opioids intrathecally through a spinal needle, followed by the placement of an

epidural catheter. CSE analgesia provides rapid pain relief with the spinal component, while the epidural catheter allows for continuous or intermittent dosing for prolonged pain relief. resulting in rapid onset and complete anesthesia below the level of injection.

It is commonly utilized for cesarean deliveries and certain operative vaginal deliveries. Spinal anesthesia provides effective surgical anesthesia and avoids the need for general anesthesia in many cases.

General Anesthesia:

It involves the administration of intravenous medications and inhalational agents to induce a state of unconsciousness and immobility. General anesthesia is commonly used for emergency cesarean deliveries or when regional anesthesia is ineffective or contraindicated. However, it carries a higher risk of maternal and neonatal complications compared to regional anesthesia.

Other Techniques:

Additional techniques such as pudendal nerve blocks, local infiltration anesthesia, and intravenous patient-controlled analgesia (PCA) may be utilized in specific obstetric scenarios, although they are less commonly employed compared to regional or general anesthesia. The selection of anesthesia technique depends on various factors, including the clinical indication, patient preferences, gestational age, maternal comorbidities, and the expertise of the anesthesia provider [5]. Each technique has its advantages and considerations, which must be carefully evaluated to ensure the best possible outcomes for both the mother and the neonate. We discussed the methods part in Fig 1.

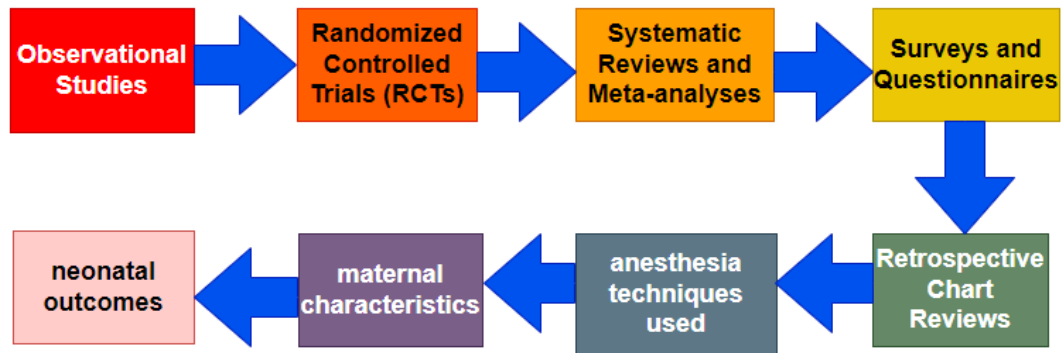


Figure 1: Methods on Anesthesia in Obstetrics: Maternal and Neonatal Outcomes

Maternal Outcomes:

Pain Relief and Maternal Satisfaction:

Effective pain relief during labor and delivery is a crucial aspect of obstetric anesthesia. It improves maternal satisfaction [6]. These techniques allow women to actively participate in the birthing process, promote relaxation, and reduce anxiety. Adequate pain relief during labor has been associated with reduced maternal stress, improved maternal-fetal bonding, and increased overall satisfaction with the childbirth experience.

Maternal Morbidity:

Hemodynamic Stability: Regional anesthesia techniques generally provide better hemodynamic stability compared to general anesthesia. Epidural analgesia, in particular, has been associated with minimal alterations in maternal blood pressure and heart rate, reducing the risk of maternal hypotension and associated complications.

Respiratory Complications: General anesthesia carries a higher risk of respiratory complications compared to regional anesthesia. The use of general anesthesia in obstetrics is associated with an increased incidence of airway-related problems, such as difficult intubation, aspiration, and postoperative respiratory depression. Regional anesthesia techniques, on the other hand, preserve

airway reflexes and reduce the risk of respiratory complications.

Neurological Complications:

Neurological complications associated with spinal anesthesia, are rare. The incidence of permanent neurological injury is extremely low, with transient symptoms being more common. These transient symptoms may include backache, headache, and sensory disturbances, which usually resolve spontaneously.

Risk of Infection: The risk of infection related to regional anesthesia techniques is minimal when appropriate aseptic techniques are followed. In contrast, general anesthesia carries a slightly higher risk of postoperative infections, primarily related to intubation and airway management.

Postpartum Hemorrhage: There is no clear evidence suggesting an increased risk of postpartum hemorrhage associated with regional anesthesia techniques. Epidural analgesia has not been found to significantly affect uterine contractility or increase the risk of postpartum hemorrhage. In fact, adequate pain relief provided by epidural analgesia may allow for improved uterine tone and more effective contraction patterns.

Maternal Mortality: Maternal mortality directly related to anesthesia in obstetrics is exceedingly rare in developed countries. Advances in monitoring techniques, anesthetic drugs, and anesthesia practice

have significantly contributed to the reduction in anesthesia-related maternal deaths. The majority of maternal deaths are associated with pre-existing maternal comorbidities rather than anesthesia-specific that while regional anesthesia techniques generally have favourable maternal outcomes, each technique carries its own risks and considerations. Proper patient selection, vigilant monitoring, and skilled anesthesia providers are essential in mitigating potential risks and ensuring optimal maternal outcomes.

Neonatal Outcomes:

Fetal Well-being: Anesthesia techniques used in obstetrics should prioritize the well-being of the fetus. Regional anesthesia, such as epidural analgesia and spinal anesthesia, have been shown to have minimal effects on fetal well-being [7]. Maternal pain relief provided by regional techniques can lead to decreased maternal stress and catecholamine release, thereby promoting better uteroplacental perfusion and fetal oxygenation.

Neonatal Resuscitation: Neonatal resuscitation may be required for newborns, particularly in cases of emergency cesarean deliveries. Regional anesthesia techniques do not impede the immediate resuscitation of the newborn if needed. The rapid onset and short duration of action associated with regional anesthesia allow for a prompt response to neonatal resuscitation efforts.

Medication Transfer and Effects: Medications used for anesthesia can cross the placenta and may potentially affect the newborn. The transfer of local anesthetics and opioids from the mother to the fetus is generally minimal but can occur. However, the doses received by the newborn are typically low and do not cause significant adverse effects. The benefits of providing adequate maternal pain relief and improving maternal outcomes generally outweigh the potential risks associated with medication transfer.

It is important to emphasize that while regional anesthesia techniques have been shown to have favorable neonatal outcomes, each case must be assessed individually, taking into account specific clinical factors. Close monitoring of the newborn's vital signs and prompt management of any neonatal complications are essential components of obstetric anesthesia care.

Overall, spinal anesthesia, have demonstrated positive neonatal outcomes and are considered safe for the newborn [8]. The use of appropriate anesthesia techniques, vigilant monitoring, and prompt neonatal resuscitation, when necessary, contribute to optimal neonatal outcomes in obstetric anesthesia practice.

Advancements in Obstetric Anesthesia:

Enhanced Recovery after Cesarean Delivery (ERACD): Enhanced Recovery after Cesarean Delivery (ERACD) is a multidisciplinary approach aimed at optimizing the perioperative care of women undergoing cesarean delivery. It focuses on evidence-based interventions to minimize surgical stress, improve pain management, and expedite recovery. ERACD protocols often include a combination of regional anesthesia techniques, such as neuraxial anesthesia, along with multimodal analgesia, early mobilization, and optimized fluid management. ERACD has shown promising results in reducing postoperative complications, improving maternal satisfaction, and shortening hospital stays.

Ultrasound-Guided Regional Anesthesia: The use of ultrasound guidance for regional anesthesia techniques has gained popularity in obstetric practice. It allows for real-time visualization of anatomical structures, improving the accuracy and safety of needle placement during procedures such as epidural analgesia and nerve blocks. Ultrasound guidance enhances the success

rate of regional blocks, reduces the risk of complications, and may result in better maternal pain relief and satisfaction.

Intrathecal Opioid Analgesia: Intrathecal opioid analgesia involves the administration of opioids directly into the subarachnoid space, providing effective pain relief during labor and delivery. It can be used as a standalone technique or as an adjunct to epidural analgesia. Intrathecal opioids, such as fentanyl or morphine, provide rapid pain relief and can be administered in low doses to minimize side effects. This technique has shown to be beneficial in cases where rapid pain relief is desired or when epidural analgesia is contraindicated or not feasible.

Nitrous Oxide Analgesia: Nitrous oxide (N₂O) analgesia, also known as "laughing gas," has been used as an adjunctive analgesic method in labor and delivery. It is self-administered by the laboring woman through a mask or mouthpiece. Nitrous oxide provides mild to moderate pain relief and has a rapid onset and offset of action. It offers a non-invasive option for pain management during labor, allowing women to have control over their pain relief. Nitrous oxide analgesia is well-tolerated, has a high patient acceptance rate.

Anesthetic Pharmacology and Safety: Advancements in anesthetic pharmacology have contributed to the safety and efficacy of obstetric anesthesia. Newer local anesthetics with favorable pharmacokinetic profiles, such as levobupivacaine and ropivacaine, have been introduced, reducing the risk of systemic toxicity. The development of short-acting opioids, such as remifentanyl, allows for precise titration of analgesia during labor. Moreover, increased awareness of the potential risks associated with certain medications, such as general anesthetics, has led to the development of safer anesthetic protocols and guidelines for obstetric patients.

These advancements in obstetric anesthesia techniques and pharmacology have the potential to improve maternal pain relief, enhance patient satisfaction, minimize maternal and neonatal complications, and expedite recovery. Continued research and innovation in obstetric anesthesia are vital to further optimize maternal and neonatal outcomes and ensure the provision of safe and effective care during labor and delivery.

Challenges and Controversies:

Timing of Regional Anesthesia: The timing of initiating regional anesthesia during labor remains a subject of debate. Some studies suggest that vaginal delivery, and longer labor duration. However, other studies have shown no significant impact on these outcomes. Balancing the benefits of pain relief with potential effects on labor progression remains a challenge, and individualized decision-making is crucial [9].

Mode of Delivery and Anesthetic Techniques: The choice of anesthetic technique for different modes of delivery can be controversial. While regional anesthesia is the preferred choice for most cesarean deliveries, the type of regional anesthesia (spinal vs. epidural) and the use of adjuvant medications (such as opioids) are topics of ongoing debate. The optimal anesthetic technique should provide effective surgical anesthesia while minimizing potential risks to the mother and neonate.

Maternal Morbidity and Long-term Outcomes: While the majority of studies demonstrate favorable maternal outcomes with regional anesthesia, there is ongoing research to further explore potential associations between anesthesia techniques and rare complications, such as postpartum backache, chronic pain, and long-term neurological effects. Continued monitoring and long-term follow-up of mothers receiving obstetric anesthesia are necessary to ensure comprehensive

understanding and detection of any potential risks.

Maternal Comorbidities and Anesthetic

Risk: Maternal comorbidities, such as obesity, hypertensive disorders, and cardiac conditions, pose challenges in the management of obstetric anesthesia. These conditions may increase the risk of anaesthesia-related complications and require careful evaluation and planning. Individualized anesthesia management strategies, including close monitoring and multidisciplinary collaboration, are essential to optimize outcomes for high-risk obstetric patients.

Medication Safety and Neonatal

Outcomes: Although medication transfer from mother to neonate during anesthesia is generally minimal, concerns regarding potential effects on neonatal respiratory depression, neurobehavioral development, and breastfeeding persist. The choice of anesthetic medications and their dosage must consider the potential impact on neonatal outcomes, and further research is needed to fully elucidate any long-term effects.

Ethical Considerations: The provision of obstetric anesthesia raises ethical considerations, particularly in cases where maternal autonomy and decision-making may conflict with concerns for fetal well-being. Balancing the mother's preferences for pain relief and the potential risks associated with anesthesia techniques can be challenging. Open communication, shared decision-making, and respect for patient autonomy are important factors in navigating these ethical dilemmas.

Addressing these challenges and controversies requires ongoing research, collaborative efforts between obstetricians and anesthesiologists, and evidence-based guidelines. Multidisciplinary teams should continually evaluate and refine obstetric anesthesia practices to improve maternal and neonatal outcomes while considering

the unique needs and preferences of each patient.

Results and discussions

Anesthesia plays a critical role in obstetric care, providing pain relief and ensuring optimal maternal and neonatal outcomes during labor and delivery. Regional anesthesia techniques, such as epidural analgesia and spinal anesthesia, have become the cornerstone of obstetric anesthesia due to their effectiveness, safety profile, and ability to promote maternal comfort and satisfaction [10]. Maternal outcomes are generally favorable with regional anesthesia, offering excellent pain relief, hemodynamic stability, and minimal respiratory complications. While rare, the risks associated with regional anesthesia, such as neurological complications and infection, should be carefully considered and addressed through proper patient selection and adherence to aseptic techniques [11].

Neonatal outcomes following anesthesia in obstetrics are typically unaffected by regional anesthesia techniques. Apgar scores, neonatal resuscitation, and long-term neurodevelopmental outcomes are comparable between infants born to mothers who received regional anesthesia and those born to mothers who did not. Medication transfer from the mother to the neonate is minimal, and the benefits of maternal pain relief generally outweigh any potential risks [12].

Despite advancements in obstetric anesthesia, challenges and controversies persist [13]. The timing of regional anesthesia initiation, choice of anesthetic techniques for different modes of delivery, management of maternal comorbidities, and concerns regarding medication safety and long-term outcomes require ongoing research and individualized decision-making [14].

Ethical considerations surrounding obstetric anesthesia highlight the importance of open communication,

shared decision-making, and respect for maternal autonomy while prioritizing fetal well-being [15].

Continued collaboration between obstetricians, anesthesiologists, and researchers is crucial to further enhance the safety, effectiveness, and patient-centeredness of obstetric anesthesia. By addressing challenges, refining techniques, and staying updated with evolving

evidence-based guidelines, healthcare providers can strive to achieve optimal maternal and neonatal outcomes, ensuring that the childbirth experience is as safe and comfortable as possible for both mother and baby.

We described the data analysis for the table 1 to 3 and graphical representation on fig 2 to fig 4.

Table 1 Safety and Risk Assessment

S. No.	Maternal Condition	Including Medical History	Allergies	Potential Risk Factors	Anesthesia
1	12	12	31	31	18
2	32	32	11	32	11
3	42	31	12	41	21
4	51	41	23	43	23
5	21	52	24	54	33
6	31	53	45	55	35
7	14	24	53	61	45

Table 2 Maternal Outcomes Monitoring and managing maternal vital signs

S. No.	Blood Pressure	Heart Rate	Oxygenation	Maternal Hypotension	Respiratory Depression	Postpartum Hemorrhage
1	0.5	0.3	0.1	0.1	0.2	0.4
2	0.4	0.2	0.2	0.2	0.3	0.3
3	0.3	0.2	0.2	0.3	0.4	0.2
4	0.6	0.1	0.1	0.2	0.5	0.1
5	0.7	0.1	0.1	0.1	0.2	0.1
6	0.6	0.1	0.1	0.2	0.2	0.2
7	0.5	0.2	0.2	0.1	0.3	0.3

Table 3 Neonatal Outcomes

S. No.	Placental Barrier	Anesthesia Techniques	Neonate	Neonatal Depression
1	70	81	89	90
2	75	86	89	90
3	80	91	95	80
4	85	96	91	70
5	82	94	94	75
6	85	76	79	79
7	80	71	70	84
8	79	75	70	90
9	82	86	80	82
10	79	82	80	87

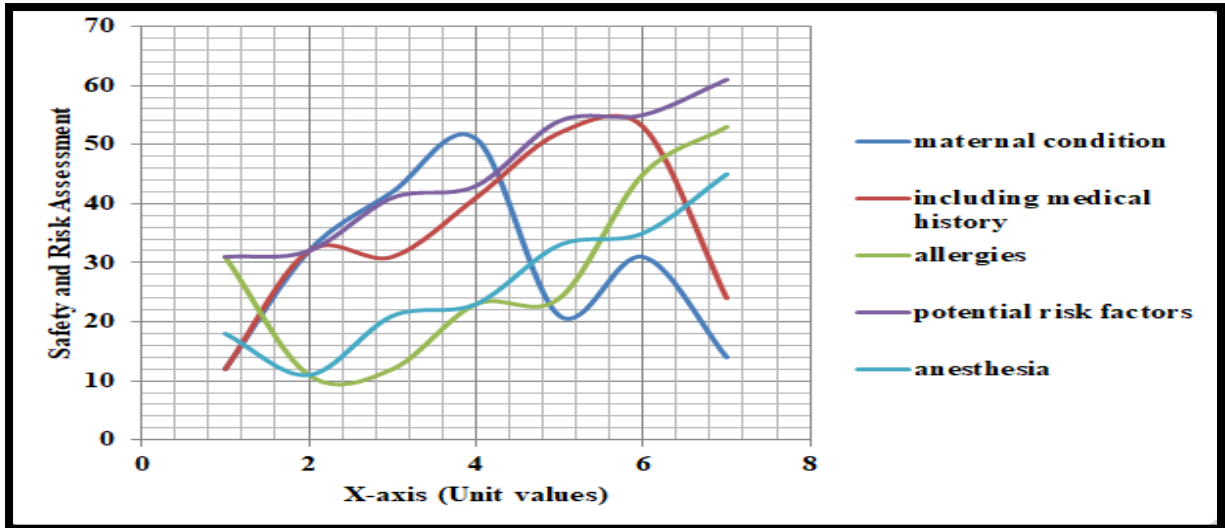


Figure 2 Line chart for Safety and Risk Assessment

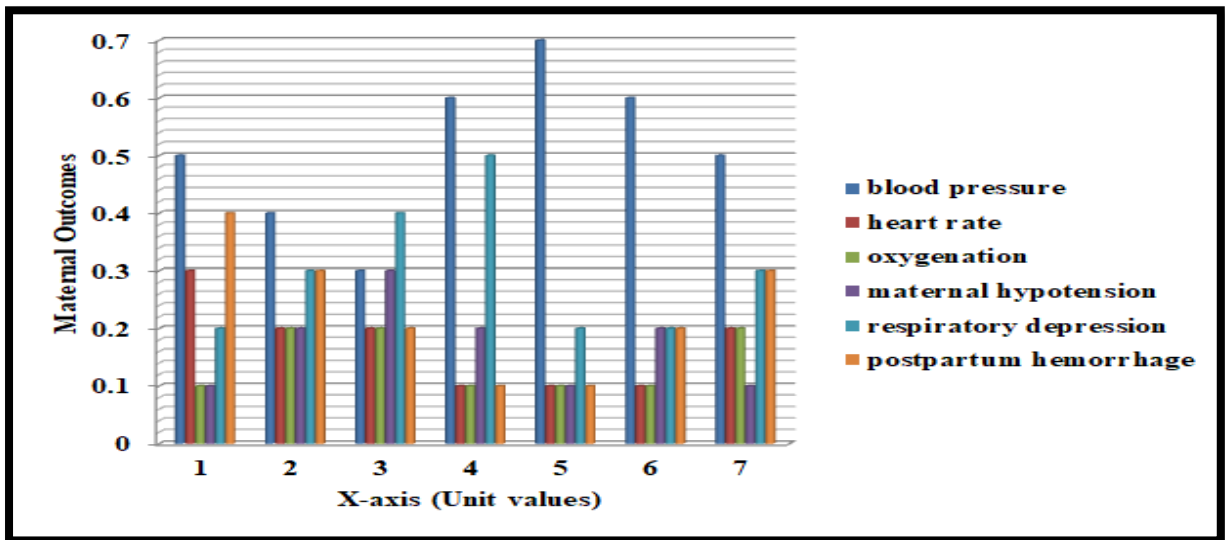
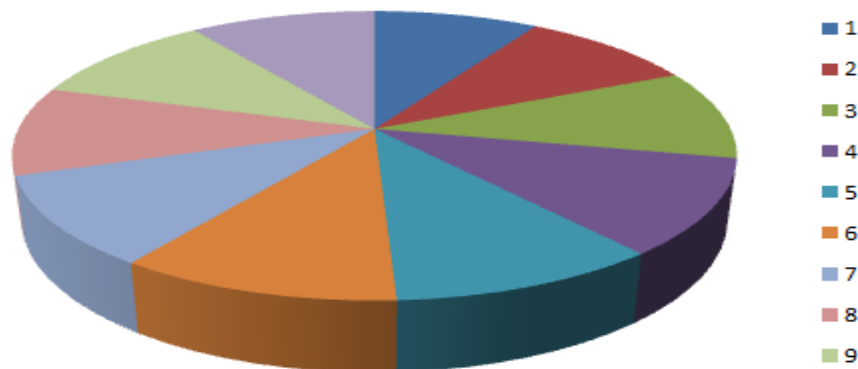


Figure 3 Maternal Outcomes Monitoring and managing maternal vital signs

placental barrier



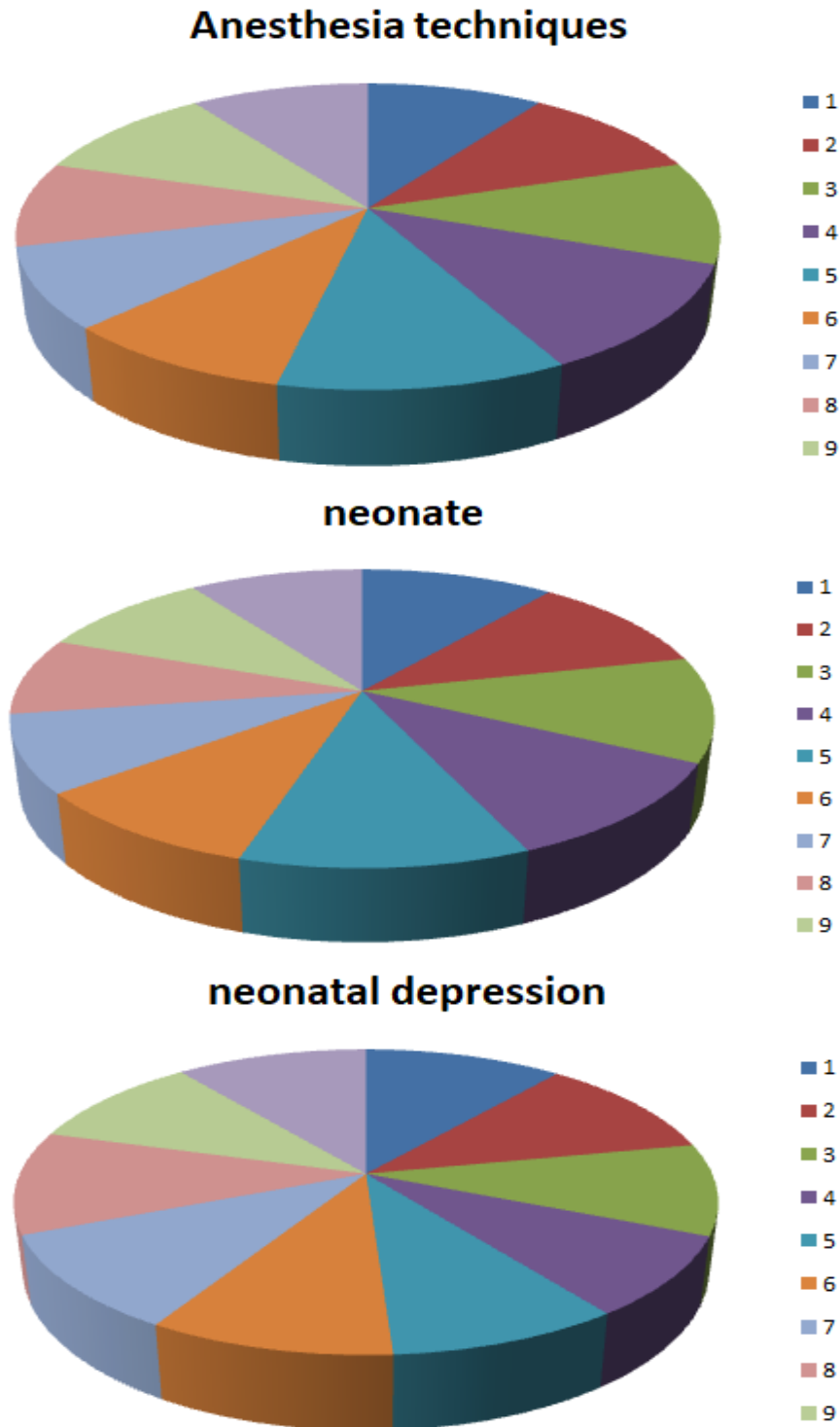


Figure 4: Neonatal Outcomes

Conclusion

Proper administration of anesthesia during childbirth is essential for ensuring the safety and well-being of both the mother and the newborn. The choice of anesthesia technique should be carefully considered, taking into account factors such as the

mother's medical condition, the stage of labor, and the anticipated mode of delivery.

Effective pain relief through anesthesia can contribute to a positive birthing experience, reduce maternal stress, and promote maternal-infant bonding.

However, anesthesia techniques must be administered with caution to minimize potential risks and complications, such as maternal hypotension, respiratory depression, or adverse effects on the newborn. Close monitoring and skilled anesthetic management by experienced professionals are crucial to optimize outcomes and ensure the well-being of both mother and baby during obstetric procedures.

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Author Contributions: **Dr Senthil Kumar Sivananthan**—conceptualization, data curation, investigation, methodology, project administration, visualization, writing—original draft, writing—review and editing, **Dr Kamala Veni** —conceptualization, methodology, writing—original draft, writing—review and editing, **Dr G Mahalakshmi** —conceptualization, visualization, supervision, writing—original draft, **Dr S.N.Saravin** —, methodology, writing—original draft, writing—review and editing. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work. All authors have read and agreed to the published version of the manuscript.

References

1. Caton D: The influence of social values on obstetric anesthesia. *AMA J Ethics* 2015; 17:253–7
2. Practice Guidelines for Obstetric Anesthesia: An Updated Report by the American Society of Anesthesiologists

- Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology. *Anesthesiology* 2016; ; 124:270–300
3. Booth JM, Pan JC, Ross VH, Russell GB, Harris LC, Pan PH: Combined spinal epidural technique for labor analgesia does not delay recognition of epidural catheter failures: A single-center retrospective cohort survival analysis. *Anesthesiology* 2016; 125:516–24
4. Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello EC, Robinson JN, Tsen LC: Dural puncture epidural technique improves labor analgesia quality with fewer side effects compared with epidural and combined spinal epidural techniques: A randomized clinical trial. *Anesth Analg* 2017; 124:560–9
5. Markley JC, Rollins MD: Non-neuraxial labor analgesia: Options. *Clin Obstet Gynecol* 2017; 60:350–64
6. BM Biccard, TE Madiba, HL Kluyts, et al. Perioperative patient outcomes in the African Surgical Outcomes Study: a 7-day prospective observational cohort study *Lancet*, 391 (2018), pp. 1589-1598
7. Shmueli A, Salman L, Orbach-Zinger S, Aviram A, Hiersch L, Chen R, Gabbay-Benziv R (2018) The impact of epidural analgesia on the duration of the second stage of labor. *Birth Issues Perinat Care* 45(4):377–384
8. Anim-Somuah M, Smyth RM, Cyna AM, Cuthbert A (2018) Epidural versus non-epidural or no analgesia for pain management in labour (Review). *Cochrane Database Syst Rev* 5:CD000331
9. Qian XY, Wang QN, Ou XX, Li P, Zhao BS, Liu HS (2018) Effects of ropivacaine in patient-controlled epidural analgesia on uterine electromyographic activities during labor. *Biomed Res Int* 2018:7162865
10. Zhao BS, Qian XY, Wang QN, Ou XX, Lin BH, Song XR (2019) The

- effects of ropivacaine 0.0625% and levobupivacaine 0.0625% on uterine and abdominal muscle electromyographic activity during the second stage of labor. *Minerva Anesthesiol* 85(8):854–861
11. Yusuke N, Mitsuru I, Ryo Y, Kazuya T, Keiko K (2019) The effect of labor epidural analgesia on labor, delivery, and neonatal outcomes: a propensity score-matched analysis in a single Japanese institute. *JA Clin Rep* 5(1):1–7
 12. Reale SC, Bauer ME, Klumpner TT, Aziz MF, Fields KG, Hurwitz R, Saad M, Kheterpal S, Bateman BT, Multicenter Perioperative Outcomes Group Collaborators. Frequency and risk factors for difficult intubation in women undergoing general anesthesia for cesarean delivery: a multicenter retrospective cohort analysis. *Anesthesiology*. 2022;136(5):697–708.
 13. Metogo JAM, Nana TN, Ngongheh BA, Nyuydzefon EB, Adjahoung CA, Tochie JN, Minkande JZ. General versus regional anaesthesia for caesarean section indicated for acute foetal distress: a retrospective cohort study. *BMC Anesthesiol*. 2021;21(1):68.
 14. Zhou C, Zhang L, Bao Y, Li L, Zhang T, Zhang X, Wang C. Effect of blood transfusion during cesarean section on postpartum hemorrhage in a tertiary hospital over a 4-year period. *Medicine*. 2021;100(3):e23885
 15. D. Chen, H. Yang, Y. Cao, et al. Expert consensus for managing pregnant women and neonates born to mothers with suspected or confirmed novel coronavirus (COVID-19) infection *Int J Gynaecol Obstet*, 149 (2020), pp. 130-136