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A Comparative Review between Propofol and Propofol plus Dexamethasone as Antiemetic During Cesarean Section under Spinal Anesthesia

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Abstract

Background: Intraoperative nausea and vomiting (IONV) after caesarean section under spinal anaesthesia is a prevalent problem that might compromise patient safety and comfort. IONV must be effectively managed to optimise maternal and neonatal outcomes. Objectives: This study is to examine the most recent information regarding the management of intra-operative nausea and vomiting after Cesarean section under spinal anaesthesia using a combination of propofol and dexamethasone. Conclusions: Propofol plus dexamethasone can be considered as a preferred antiemetic strategy for cesarean section under spinal anesthesia. It offers superior efficacy in reducing IONV, which contributes to improved patient satisfaction. However, individual patient factors, contraindications, and known risks associated with dexamethasone should be taken into consideration.

Keywords: Cesarean Section, Spinal Anesthesia, Intraoperative Nausea and Vomiting, Propofol, Dexamethasone, Antiemetic Strategy.

1. Introduction

Neuraxial anesthesia, such as spinal anesthesia, is the preferred choice for cesarean section procedures due to its advantages over general anesthesia. General anesthesia carries risks associated with airway complications, aspiration, and increased uterine atony resulting in higher blood loss [1]. In recent years, cesarean section with spinal anesthesia has gained significant attention and has become a widely adopted surgical practice. However, a common issue encountered during cesarean section under spinal anesthesia is the occurrence of intra and postoperative nausea and vomiting (IONV and PONV). These symptoms can manifest during or after birth, impacting the well-being of both the mother and the newborn. PONV, in particular, can lead to serious complications such as airway obstruction, aspiration pneumonia, and wound dehiscence [2].

Nausea is an unpleasant subjective experience followed by a conscious urge to vomit. Retching, on the other hand, is characterised by spasmodic contractions of respiratory muscles, such as the diaphragm, chest wall, and abdominal muscles, without the ejection of gastric contents. Strong contractions of the abdominal muscles, lowering of the diaphragm, and opening of the gastric cardia result in vomiting, which is the forceful ejection of gastric contents [2].

There are numerous causes of nausea and vomiting. These include hypotension, a typical complication of regional anaesthetic, and decreased cardiac output due to aortocaval compression. Surgical stimulation, such as the manipulation of the uterus during a caesarean section, and the administration of certain drugs, such as opioids and uterotonics, can also induce nausea and vomiting [3].

Propofol, a diisopropylphenol derivative, is frequently used for the induction and maintenance of anaesthesia during surgical procedures. Even in subhypnotic doses, propofol has been reported to possess antiemetic effects. Despite the fact that the precise mechanism of its antiemetic activity is not entirely understood, numerous hypotheses have been offered. Among these include a direct depressive effect on the chemoreceptor trigger zone (CTZ), the vagal nuclei, and other regions implicated in the aetiology of postoperative nausea and vomiting (PONV) [4]. Studies on animals have demonstrated that propofol can inhibit synaptic neuronal transmission in the olfactory brain and reduce serotonin levels in the region postrema, which contributes to its antiemetic effects [5].

Dexamethasone is renowned as a robust medicine with potent antiemetic and anti-inflammatory effects, able to efficiently and fully manage and control nausea and vomiting. Although the actual mechanism underlying dexamethasone's antiemetic effect is not completely understood, it is thought to entail suppressing prostaglandin formation, exerting anti-inflammatory effects, and limiting the release of endogenous opioids [6].

Clinical evidence has demonstrated that a sub-hypnotic dose of propofol at 1.0 mg/kg/h is the minimum effective dosage for mitigating emetic symptoms during cesarean section procedures. Increasing the dosage to 2.0 mg/kg/h does not provide any additional advantages in terms of antiemetic efficacy. Conversely, administering dexamethasone prior to surgery, specifically at a dose of 8 mg, has been shown to effectively reduce the occurrence of postoperative nausea and vomiting (PONV) in cesarean section patients [7].

These results demonstrate that dexamethasone has potent antiemetic actions and can treat both nausea and vomiting. In addition, they underline the need of using sub-hypnotic doses of propofol after caesarean delivery to effectively treat emetic symptoms. Preoperative dexamethasone injection at the indicated dosage can greatly reduce the incidence of postoperative nausea and vomiting (PONV). Collectively, these measures contribute to increasing

patient comfort and enhancing caesarean section outcomes [6].

Therefore, this review aims to view the latest updates about management of Intra-operative nausea and vomiting during Cesrean section under spinal anaethsia using propofol and dexamethasone combination.

2. Pathophysiology of intraoperative nausea and vomiting (IONV):

Intraoperative nausea and vomiting (IONV) during cesarean section under spinal anesthesia can significantly impact the patient's well-being and surgical experience. Understanding the pathophysiology and contributing factors is crucial in effectively managing and preventing IONV [8].

The pathophysiology of IONV is multifactorial and involves complex interactions between the central nervous system, the chemoreceptor trigger zone (CTZ), the gastrointestinal system, and various neurotransmitters and receptors. Several factors contribute to the occurrence of IONV [9] **(Table 1)**:

Table (1) Factors Contributing to IONV during Cesarean Section under Spinal Anesthesia

	Impact on Patient Outcomes
Hypotension	- Activation of CTZ leading to nausea and vomiting
Surgical Stimulation	- Development of stress response - Increased risk of IONV - Aspiration risk
Intraoperative Medications	- Airway obstruction - Surgical complications - Hemodynamic instability

I. Hypotension:

Spinal anesthesia commonly causes hypotension due to sympathetic blockade, resulting in reduced cardiac output and perfusion to vital organs. Hypotension can stimulate the CTZ, triggering nausea and vomiting [10].

II. Surgical Stimulation:

Cesarean section-related surgical techniques, including as uterus exteriorization and manipulation, can produce a stress response and result in visceral traction. These stimuli can contribute to the onset of IONV by activating afferent neural pathways [11].

III. Intraoperative Medications:

Certain medications administered during cesarean section, such as opioids and uterotonics, can increase the risk of IONV. Opioids, commonly used for pain management, can directly stimulate the CTZ and cause nausea and vomiting. Uterotonics, such as oxytocin, may also contribute to IONV [11].

The effect of IONV on patient outcomes is substantial and should not be minimised. It might cause the patient discomfort, discontent, and anguish. Additionally, IONV may have negative effects, such as [12]:

a. Aspiration Risk: Vomiting during cesarean section can increase the risk of aspiration, which can lead to pulmonary complications such as aspiration pneumonia [12].

b. Airway Obstruction: Severe vomiting can cause airway obstruction, compromising oxygenation and requiring immediate intervention [13].

c. Surgical Complications: Intense abdominal muscle contractions during vomiting may increase the risk of wound dehiscence, especially in patients with a higher risk, such as those with previous surgical scars [14].

d. Hemodynamic Instability: IONV-associated sympathetic activation and subsequent hemodynamic changes, such as tachycardia and hypertension, can have adverse effects on maternal and fetal well-being [15].

3. Propofol as an Antiemetic:

Propofol, a commonly used intravenous anesthetic agent, has been recognized for its antiemetic properties. Understanding the pharmacology, evidence supporting its use, optimal dosage, and safety profile is crucial in evaluating propofol as an antiemetic strategy during cesarean section under spinal anesthesia [16].

✓ **Pharmacology and Mechanism of Action:**

Propofol is a short-acting intravenous anesthetic agent with sedative-hypnotic properties. Its pharmacokinetic profile includes rapid onset of action and a short duration of effect. The exact mechanism of propofol's antiemetic effect is not fully understood. However, several mechanisms have been proposed [17]:

Direct depression of the chemoreceptor trigger zone (CTZ) in the brain, which plays a crucial role in triggering emetic responses. Inhibition of the vagal nuclei and other centers implicated in the pathogenesis of postoperative nausea and vomiting (PONV). Modulation of neurotransmitters such as serotonin and dopamine, which are involved in the emetic pathway. Decreased synaptic nerve transmission in the olfactory cortex and decreased serotonin levels in the area postrema, further contributing to its antiemetic properties [18].

✓ **Evidence supporting the use of propofol as an antiemetic:**

Several studies have investigated the effectiveness of propofol in reducing the incidence of PONV during cesarean section under spinal

anesthesia. These studies have shown favorable results, with propofol demonstrating antiemetic efficacy. Propofol has been found to significantly reduce the occurrence of PONV when compared to placebo or other antiemetic agents [19].

✓ **Optimal dosage and administration regimen:**

Determining the optimal dosage and administration regimen of propofol for antiemetic effect depends on various factors, including patient characteristics, surgical procedure, and individual response. According to studies, a subhypnotic dose of propofol, typically 1.0 mg/kg/h, can successfully minimise emetic sensations during caesarean delivery. However, raising the dose to 2.0 mg/kg/h does not provide any additional antiemetic benefit. The continuous administration of propofol during surgery has been demonstrated to be effective in preventing PONV [20].

✓ **Efficacy, safety, and limitations:**

Propofol has showed efficacy as an antiemetic during spinal anesthesia-assisted caesarean delivery. It has been demonstrated to reduce the incidence and severity of PONV, hence enhancing patient comfort and satisfaction. In addition, the quick onset and brief duration of action of propofol make it an excellent candidate for antiemetic therapy [21].

In terms of safety, propofol is generally well-tolerated and has few side effects. However, it is essential to consider potential adverse effects such as hypotension, respiratory depression, and brief injection site soreness. Careful monitoring and dose modifications are required to reduce these hazards [22].

The short duration of propofol's antiemetic effects is one of the drug's drawbacks. Due to the short half-life of propofol, further antiemetic treatments may be necessary to treat postoperative nausea and vomiting. Consider combining propofol with additional antiemetic medicines, such as dexamethasone, to improve the antiemetic impact and give longer-lasting relief [23].

4. Dexamethasone as an Antiemetic:

Dexamethasone, a synthetic corticosteroid, has gained recognition as an effective antiemetic agent in various clinical settings, including cesarean section under spinal anesthesia. Understanding its pharmacology, mechanism of action, available evidence, optimal dosage, and safety profile is crucial in evaluating dexamethasone as an antiemetic strategy in this context [6]**(Table 2)**.

Table (2) Summary of Dexamethasone as an Antiemetic during Cesarean Section under Spinal Anesthesia

Aspect	
Pharmacology	Dexamethasone is a synthetic corticosteroid with potent anti-inflammatory, immunosuppressive, and antiemetic properties.
Mechanism of Action	- Binds to cytoplasmic glucocorticoid receptors, modulating gene expression. - Inhibition of prostaglandin synthesis and release. - Suppression of inflammatory response and pro-inflammatory cytokines. - Modulation of neurotransmitters involved in the emetic reflex.
Evidence	- Effective in reducing the incidence and severity of PONV during cesarean section under spinal anesthesia. - Demonstrates particular efficacy in the early postoperative period.
Optimal Dosage and Timing	- Preoperative administration of 8 mg intravenously is commonly used for prophylactic antiemetic effect. - Lower doses (4-5 mg) have shown efficacy in certain patient populations. - Timing is critical, with peak effect occurring 2-4 hours after administration and lasting for 24 hours or more.
Efficacy	- Reduction in the incidence and severity of PONV. - Improved patient satisfaction.
Safety	- Generally well-tolerated as a single prophylactic dose. - Potential side effects: hyperglycemia, immunosuppression, hypothalamic-pituitary-adrenal axis suppression (associated with chronic or high-dose use).
Drawbacks	- Limited efficacy in certain patient populations or in those with a high risk of PONV or previous exposure to multiple antiemetic drugs.

✓ **Pharmacology and Mechanism of Action:**

Dexamethasone is a potent glucocorticoid that exhibits anti-inflammatory, immunosuppressive, and antiemetic properties. It acts through binding to cytoplasmic glucocorticoid receptors, leading to the modulation of gene expression. The exact mechanism of dexamethasone's antiemetic effect is not fully understood, but several mechanisms have been proposed [24]:

Inhibition of the synthesis and release of prostaglandins, which are known to play a role in the emetic pathway. Suppression of the inflammatory response and reduction of pro-inflammatory cytokines, potentially mitigating the occurrence of nausea and vomiting. Modulation of neurotransmitters, such as dopamine and serotonin, involved in the regulation of the emetic reflex [25].

- ✓ **Evidence supporting the use of dexamethasone as an antiemetic:**

Multiple studies have investigated the efficacy of dexamethasone in preventing postoperative nausea and vomiting (PONV) during cesarean section under spinal anesthesia. The available evidence suggests that dexamethasone is effective in reducing the incidence and severity of PONV when compared to placebo or other antiemetic agents. It has shown particular efficacy in the early postoperative period [26].

- ✓ **Optimal dosage and timing of dexamethasone administration:**

The optimal dosage and timing of dexamethasone administration for antiemetic effect depend on various factors, including patient characteristics, surgical procedure, and individual response. A commonly utilized dose for prophylactic antiemetic effect is 8 mg of dexamethasone given intravenously before induction of anesthesia. Studies have shown that a single preoperative dose of 8 mg is effective in reducing PONV during cesarean section. However, lower doses (4-5 mg) have also demonstrated antiemetic efficacy in certain patient populations [6].

Timing of administration is crucial, as dexamethasone's effect peaks approximately 2-4 hours after administration and lasts for 24 hours or more. Therefore, administering dexamethasone preoperatively ensures adequate drug concentration during the critical period when PONV is most likely to occur [27].

- ✓ **Efficacy, safety, and potential drawbacks:**

Dexamethasone has demonstrated efficacy as an antiemetic agent during cesarean section under spinal anesthesia. It has been associated with a reduction in the incidence and severity of PONV, leading to improved patient satisfaction. Additionally, dexamethasone has a prolonged duration of action, providing antiemetic effect beyond the intraoperative period [28].

Regarding safety, dexamethasone is generally well-tolerated when administered as a single dose. However, it is important to consider potential side effects such as hyperglycemia, immunosuppression, and hypothalamic-pituitary-adrenal axis suppression. These side effects are typically associated with chronic or high-dose corticosteroid use, which is not typically encountered with a single prophylactic dose of dexamethasone [29].

One potential drawback of dexamethasone is its limited efficacy in certain patient populations, such as those with a high risk of PONV or who have received multiple antiemetic drugs in the past. In such cases, combination therapy with other antiemetic agents or alternative strategies may be considered [30].

5. Efficacy of Propofol Plus Dexamethasone for IONV Management:

The efficacy of combining propofol and dexamethasone as an antiemetic strategy during cesarean section under spinal anesthesia has been investigated in several clinical studies. These studies have aimed to evaluate the effectiveness of the combination therapy compared to propofol alone or other antiemetic regimens. This article offers a literature review on the efficacy of propofol and dexamethasone for the management of intraoperative nausea and vomiting (IONV) after caesarean surgery [31].

Multiple clinical studies have revealed the potential benefits of combining propofol and dexamethasone as an antiemetic. Compared to propofol alone or other antiemetic medications, these trials demonstrate a considerable reduction in the incidence and severity of IONV [32, 33]. In a randomised controlled experiment, Wang et al. (2017) compared propofol with dexamethasone to propofol alone and found that the combination medication group had a significantly decreased incidence of nausea and vomiting [34].

In addition to reducing the incidence of IONV, the combination of propofol and dexamethasone has demonstrated prospective benefits in terms of increased antiemetic efficacy and extended duration of action. Abdel-Ghaffar et al. (2019) compared propofol plus dexamethasone to the routinely used antiemetic ondansetron and discovered that the combination medication gave higher antiemetic efficacy and longer duration of action. This prolonged antiemetic action is especially advantageous in the postoperative period, when patients may continue to be at risk for PONV [35].

Additionally, the combination of propofol and dexamethasone has demonstrated excellent outcomes in the prevention of delayed PONV, which can develop several hours after surgery. According to a study by Khan et al. (2020), combined therapy is more effective than propofol alone in lowering the incidence of both early and delayed PONV [36].

The combination of propofol and dexamethasone has proven favourable results in the management of IONV following caesarean section, although it is not without limitations. Consider and weigh the adverse effects of dexamethasone, such as hyperglycemia and immunosuppression, against the potential benefits. Additionally, when determining the appropriate antiemetic strategy, unique patient characteristics and circumstances, such as the existence of comorbidities, should be considered [37].

6. Comparative analysis of propofol alone versus propofol plus dexamethasone as antiemetic strategies during cesarean section under spinal anesthesia.

Table (3) comparative analysis of propofol alone versus propofol plus dexamethasone as antiemetic strategies during cesarean section under spinal anesthesia

Comparative Analysis Factors	Propofol Alone	Propofol Plus Dexamethasone
Antiemetic Efficacy	Moderate	Superior
Safety Profiles and Adverse Effects	Well-tolerated, mild adverse effects (hypotension, respiratory depression)	Well-tolerated, minimal adverse effects (potential risks of hyperglycemia, immunosuppression, delayed wound healing)
Synergistic Effects and Interactions	Single pathway targeting (direct CNS depression, neurotransmitter modulation)	Potential synergistic effects by targeting different pathways involved in emetic response
Cost-Effectiveness and Practical Considerations	Potential cost savings from reduced use of rescue antiemetics and postoperative complications Ease of administration Compatibility with other medications and anesthesia protocols	Additional cost due to dexamethasone

7. Conclusion and future prospective:

In conclusion, the comparative analysis of propofol alone and propofol plus dexamethasone as antiemetic methods during spinal anesthesia-facilitated caesarean section shows significant insights. Propofol with dexamethasone had greater antiemetic efficacy compared to propofol alone, resulting in decreased incidence of intraoperative nausea and vomiting (IONV) and enhanced patient comfort. The safety profiles of both treatments are favourable, although the inclusion of dexamethasone may pose concerns such as hyperglycemia and delayed wound healing. Different pathways involved in the emetic response are targeted by the combination of propofol and dexamethasone, which may result in synergistic effects. However, practical issues include cost-effectiveness, administration simplicity, and compatibility with other drugs and anaesthetic procedures.

Propofol plus dexamethasone can be deemed a preferred antiemetic therapy for caesarean section under spinal anaesthesia based on the data. It has higher efficacy in decreasing IONV, hence enhancing patient satisfaction. However, patient-specific characteristics, contraindications, and recognised dangers associated with dexamethasone must be considered. To validate the existing findings and determine the appropriate dosage and timing of propofol and dexamethasone administration, additional study is required. To acquire a thorough understanding of these antiemetic treatments, it is necessary to investigate their long-term effects and possible interactions with other anaesthetic and surgical approaches.

In conclusion, the combination of propofol and dexamethasone is a promising strategy for managing IONV during spinal anesthesia-assisted caesarean delivery. Future research and clinical experience will continue to develop the most effective antiemetic therapies for this particular surgical situation. Clinical decision-making requires individualised patient evaluation, financial considerations, and potential dangers linked with dexamethasone. Continued research efforts will help to the enhancement of patient outcomes and IONV management in this population.

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