

Effectiveness of Single Intravenous Dexamethasone in Prolongation of Spinal Anesthesia for Postoperative Analgesia in Elective Cesarean Section: A Systematic Review of Randomized Controlled Trials

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Background: The analgesic effectiveness of a single perioperative dose of dexamethasone is not clearly defined. The administration of systemic medication like dexamethasone, opioids, and non-steroidal anti-inflammatory drugs has a positive effect on the prolongation of postoperative analgesia after cesarean section under spinal anesthesia. A single-dose administration of dexamethasone with moderate to high dose reduces postoperative pain, reduces opioid consumption, and prolongs spinal anesthesia after cesarean delivery.

Objective: The aim of this systematic review was to investigate the effectiveness of single intravenous dexamethasone in prolongation of spinal anesthesia for postoperative analgesia in elective cesarean section.

Methods: We conducted a search on PubMed, Google Scholar, the Cochrane Library, Hinari, and review articles on the effectiveness of intravenous dexamethasone for extending spinal anesthesia during elective cesarean sections, until June 2023. The searches were conducted by using keyword (IV dexamethasone OR/AND analgesia OR postoperative pain AND cesarean section OR child birth AND prolongation of spinal anesthesia). The articles included describe the analgesic efficacy of dexamethasone for prolongation of spinal anesthesia during cesarean section.

Results: A total of 25,384 papers were found using different searching methodologies from different electronic databases. The EndNote reference manager was used to remove duplicates, and 438 articles were selected for screening. Of those, 57 were included for critical evaluation, and 49 were removed with justification. The effectiveness of IV dexamethasone on the prolongation of spinal anesthesia and postoperative analgesia in women undergoing cesarean delivery is the subject of eight RCT studies on 628 parturients that are presented in the chosen journal articles from various countries.

Conclusion: Intravenous dexamethasone administration immediately after clamping of the umbilical cord prolongs the duration of spinal block in patients undergoing cesarean sections and has a significant impact on reduction of postoperative pain severity, opioid consumption, and other pain requirements. When high-dose dexamethasone is administered intravenously, it can overcome complications that may arise after severe pain and increase patient satisfaction by extending the duration of postoperative analgesia and sensory block.

Keywords: dexamethasone, prolongation, spinal anesthesia, analgesia, caesarean section systematic review

Introduction

Currently, the prevalence of cesarean section is around 21%, and cesarean section is defined as the delivery of a fetus via a uterine incision (hysterotomy) and an open abdominal incision (laparotomy).¹ Over-the-counter or injectable medications can be used to manage post-cesarean pain. Based on the level of pain and whether they underwent general, spinal, or epidural anesthesia, the choice of painkillers following a cesarean delivery will vary. Through the injection of a local anesthetic into the subarachnoid

space, the lower body is rendered numb through the technique of spinal anesthesia. Local anesthetic is injected into the spinal canal to stop the conduction of nerve impulses, reducing pain sensitivity without unconsciousness. During cesarean delivery it improves outcomes of both the fetus and maternal conditions by avoiding the complication of general anesthesia, and also it has prolonged analgesic effect.¹

The approach to treating acute surgical pain has changed to include protocols for improved recovery following cesarean section and a reduction in the use of opioids by administering a combination of various medications with analgesic effect. This method, sometimes referred to as balanced analgesia, aims to obtain additional analgesic benefits while lowering the quantity of opioids needed to minimize side effects, which helps to increase the enhanced recovery from anesthesia and surgery.²

Numerous ailments have been treated with dexamethasone. The chronic use of dexamethasone also inhibits phospholipase, which is required for the inflammatory chain reaction along the cyclooxygenase and lipoxygenase pathways. In addition it blocks the C-fibers of the pain pathway, which contributes to its analgesic effects. The systemic administration of dexamethasone has the potential to lengthen the duration of analgesia and reduce the severity of postoperative pain, opioid consumption, and sleep disturbance during the first night following surgery with minimal adverse effects.^{2,3}

Intraoperative administering of high-dose dexamethasone (greater than 0.2 mg/kg) reduces postoperative pain and spares opioids. After surgical procedures, an effective multimodal pain management strategy using intermediate dose dexamethasone (0.11 to 0.2 mg/kg) has been found to be safe with minimal side effects. During cesarean sections, preoperative IV dexamethasone administration has a stronger impact on postoperative pain management.⁴

Intravenous dexamethasone prolongs spinal anesthesia during a cesarean section, improving pain control, and lowering postoperative pain and opioid consumption. It also lessens sore throats caused by intubation and reduces opioid consumption. Additionally, there is a decreased incidence of rebound pain when intraoperative IV dexamethasone is administered. Early postoperative administration of a single intravenous dose of dexamethasone 0.1 mg/kg significantly reduces the need for overall analgesic medication and provides a substantial analgesic benefit.⁵

Administering high-dose dexamethasone intraoperatively (greater than 0.2 mg/kg) reduces postoperative pain and spares opioids. Following surgery, an effective multimodal pain management strategy is the use of intermediate dose dexamethasone (0.11 to 0.2 mg/kg), which is safe and has few side effects. Preoperative IV dexamethasone administration has a stronger impact on postoperative pain control during cesarean delivery.⁶ Additionally, there is a decreased incidence of rebound pain when intraoperative IV dexamethasone is administered. A single intraoperative dose of dexamethasone 0.1 mg/kg reduces the need for overall analgesics by providing a substantial analgesic benefit in the early postoperative phase.⁷

This systematic review set out to bring the body of research on dexamethasone's effectiveness for postoperative analgesia and spinal anesthesia prolongation in women having cesarean deliveries up to date and draw conclusions. Additionally, it offers dosage guidelines for achieving the best possible effects from this medication.

Review Question

We reviewed the literature to gather information on postoperative pain management methods, identifying the most suitable technique of postoperative analgesia modality and the efficacy of dexamethasone as a prolongation of spinal anesthesia and postoperative analgesia in women undergoing cesarean delivery.

Methods and Material

Protocol

We report our systematic review by using preferred reporting of systematic review and meta-analysis (PRISMA).

Eligibility Criteria

Inclusion Criteria

All randomized controlled trials written in English language, full original length article from 2013–2023 that documented the efficacy of intravenous dexamethasone in extending spinal anesthesia for postoperative analgesia following an elective cesarean section were reviewed.

Exclusion Criteria

Study done on the effectiveness of intravenous dexamethasone administration in prolongation of postoperative analgesia after spinal anesthesia but on other than pregnant populations, case reports, studies that only included abstracts, observational studies, and cross-sectional and cohort studies were excluded from the review.

Searching Strategy

Google Scholar, PubMed, and Cochrane databases (Cochrane Central Register of Controlled Trials; Cochrane Database of Abstracts or Reviews of Effects; Cochrane Database of Systematic Reviews) were searched for randomized controlled trials published from 2013 to June 2023. The search was done by using keywords, phrases, and specific subject headings. Articles were searched for IV dexamethasone OR hexadecadrol AND analgesia OR postoperative pain AND cesarean section OR child birth AND prolongation of spinal anesthesia after keywords were extracted.

Generally 25,384 articles were identified through database searching strategies. Eight randomized controlled trials on 628 pregnant women were evaluated for quality and conclusion after the results were extracted and filtered according to the interventions, publication year, outcome, population data, and methodological quality, as well as inclusion and exclusion criteria. Articles included examined the effects of intravenous (IV) dexamethasone on prolongation of spinal anesthesia and reduced postoperative pain scores and analgesic requirements. Based on the quality of evidence referred from the Oxford Centre for Evidence-Based Medicine, a conclusion was reached and recommendations were made.

The quality of evidence was evaluated by the GRADE system (Table 1), and the system incorporates study quality (risk of bias) comparison of effectiveness across study, PICO (population, intervention, comparator, and outcome), and certainty.⁸

PICO of this systematic review

P: Study done on pregnant women who had spinal anesthesia for elective cesarean section

I: Study that has full article and done on IV dexamethasone administration after spinal anesthesia

C: Those women not taking IV dexamethasone after spinal anesthesia

O: The analgesic prolongation of IV dexamethasone after spinal anesthesia on pregnant women who underwent elective cesarean section

Data Extraction

The data were extracted by three different reviewers using a customized Excel sheet; disagreements or conflicts were resolved by consensus or another means. Information on the patient population's socio-demographics, sample size, research design with level of evidence, year of publication, main outcome, complications from interventions, and surgical duration were all obtained.

Data Synthesis and Quality Assessment

During the systematic review process, all of the relevant studies were incorporated into the synthesis. For every outcome, $P < 0.05$ was regarded as statistically significant. The Cochrane Collaboration and the risk of bias assessment tool from

Table 1 Grade of Recommendation and Level of Evidence

Level	Type of Evidence	Degrees of Recommendations
1a	Meta-analyses, systematic reviews of randomized controlled trials	Strongly recommended and directly applicable
1b	Systematic review of non-randomized controlled trials	Highly recommended and directly applicable
1c	Randomized controlled trials (RCTs)	Recommended and applicable
2a	Evidence-based guidelines	Extrapolated evidence from other studies
3a	Non-analytic studies such as cohort, surveys, case reports, and case series	Extrapolated evidence from other studies

Note: Good clinical practice, GCP, WHO, 2011.

ROBIN were used to evaluate the methodological quality and bias risk of each included study. The instrument is used to assess research quality along two dimensions: internal validity (evaluating the data collection method, case definition, study instrument, and mode of data collection) and external validity (evaluating the target population, sampling frame, and sampling).

Critical Appraisal

The risk of bias was assessed using the risk of bias assessment technique for RCT trials developed by the Cochrane Collaboration. The methodological quality of all eight RCT studies was assessed using the ROB tool, which has components for selection bias (random sequence generation and allocation concealment), performance bias (blinding of participants and personnel), detection bias (blinding of outcome assessment), attrition bias (incomplete outcome data), reporting bias (selective reporting), and other bias (as shown in Table 2 below).

Results

A total of 25,384 studies were found using different searching methodologies from different electronic databases. The EndNote reference manager was used to remove duplicates, and 438 articles were selected for screening. Of those, 57 were included for critical assessment and 49 were removed with justification (Figure 1). The effectiveness of IV dexamethasone on the prolongation of spinal anesthesia and postoperative analgesia in women undergoing cesarean delivery is the subject of eight RCT studies that are presented in the chosen journal articles from different countries (Table 3).^{9-12,16}

Discussion

The results of this review suggest that intermediate to high dose of IV dexamethasone provides a substantial additional benefit to the analgesic's duration or sensory blockade after intrathecal anesthesia in non-emergency cesarean section. Furthermore, our findings suggest that IV dexamethasone can help reduce cumulative opioid use and postoperative pain. Finally, intravenous dexamethasone does not seem to have any negative effects on the new-born's Apgar score or cause long-term complications for the mother.

Dexamethasone has been shown in numerous trials to have the ability to increase the duration analgesia of spinal anesthesia, lower postoperative pain levels, and reduce quantity of opioids needed following a procedure. Intravenous dexamethasone and wound site infiltration of local anesthetics agents significantly reduced the need for postoperative analgesics and pain perception for up to one day following a cesarean section, with no negative effects on the surgical

Table 2 Risks of Bias Assessments (ROB)

Studies (Reference No)	Selection Bias		Performance Bias	Detection Bias	Attrition Bias	Reporting Bias	Other Bias	ROB
	Random Sequence Generation	Allocation Concealment						
Shahraki et al, 2013 ⁹	I	I	I	I	I	I	0	6
Patnaik et al, 2020 ¹⁰	I	I	I	I	I	I	0	6
Maged et al, 2018 ¹¹	I	I	I	I	I	I	0	6
Shalu et al, 2017 ¹²	I	I	0	I	I	I	0	5
Mehdiratta et al, 2021 ¹³	I	I	I	0	I	I	0	5
Vinutha V et al, 2019	I	I	I	I	I	I	0	6
Manohar et al, 2023 ¹⁴	I	I	0	I	I	I	0	5
Cardoso et al, 2013 ¹⁵	I	I	I	I	I	I	0	6

Notes: ROB: 1-3=high risks (H), 4-7=low risks (L), 0=no risk, 1=there is a risk, 2=uncertain.

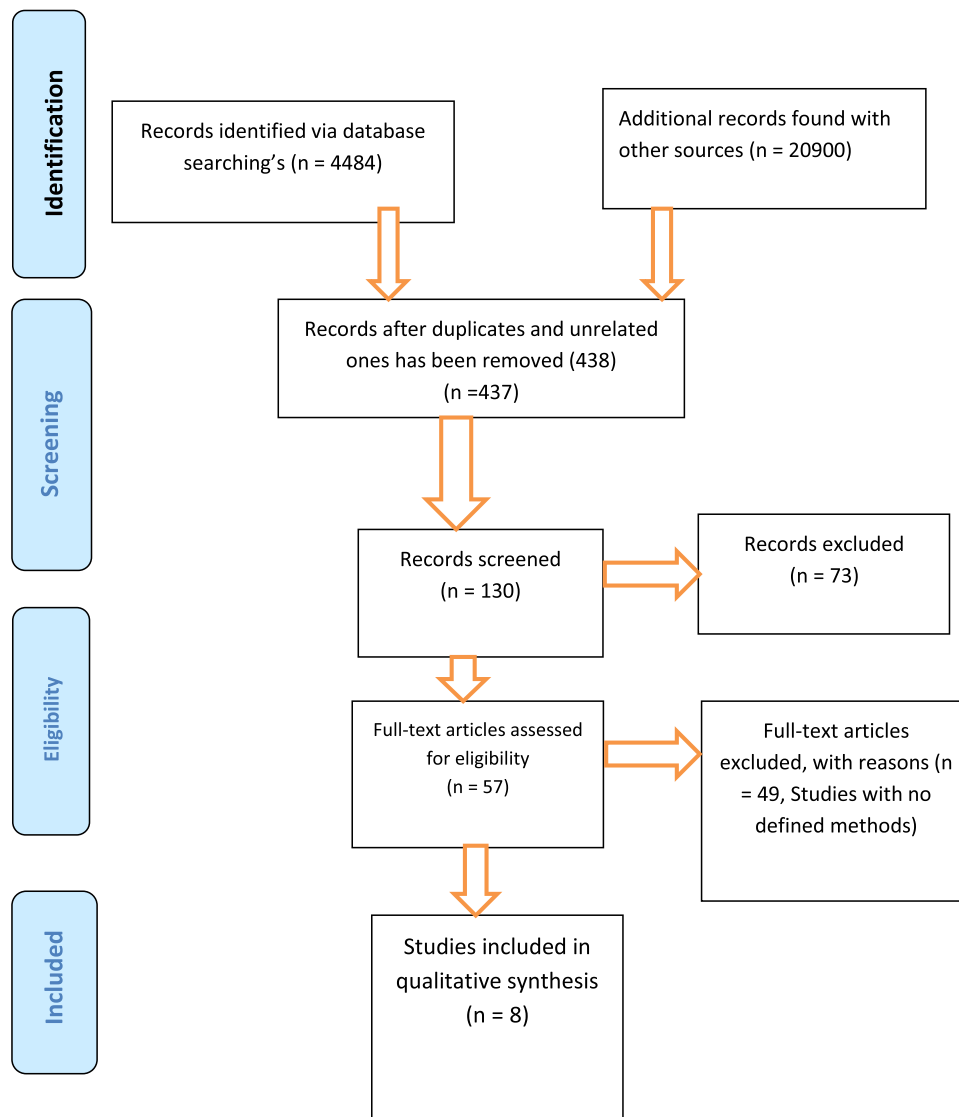


Figure 1 PRISMA flow diagram for the searched and used articles.

site or respiratory tract infection.¹¹ However, few studies have looked at maternal opioid consumption, and pain scores were not decreased by preoperative low to intermediate doses of intravenous dexamethasone administration for cesarean delivery under spinal anesthesia or in conjunction with a multimodal postoperative analgesic regimen that includes intrathecal morphine.¹³

The efficacy of dexamethasone in treating cerebral edema and the subsequent elevations in intracranial pressure caused by tumors and metastatic lesions has been demonstrated in numerous medical conditions. Its glucocorticoid structure is long and efficient, and its analgesic effects stem from blocking the C-fibers of the pain pathway and inhibiting phospholipase, which is required for the inflammatory chain reaction along the cyclooxygenase and lipoxygenase pathways.^{5,17}

Multiple studies have demonstrated that administration of dexamethasone 8 mg intravenously extends the duration of postoperative analgesia spinal anesthesia after cesarean section and decreases postoperative opioid consumption.^{9,10,12} Patients who underwent cesarean sections with spinal anesthesia benefit from preoperative dexamethasone 0.1 mg/kg intravenous administration because it reduces pain following surgery (intensity of postoperative pain) by lengthening the sensory receptor block, reduces opioid taken in its entirety on the first postoperative day, and reduces other analgesic requirement; it improves sleep the night after surgery; and a single dose has no impact on the prevalence of surgical site infection or wound healing.^{5,16}

Table 3 Summary of Articles Used for the Development of This Systematic Review

Study no	Authors (Year) (Reference no)	Study Population	Data Collection Method	Sampling Method	Study Type	ROB	Outcome
1	Shahraki et al, 2013 ⁹	60	Questionnaire	Random	RCT	Low	IV dexamethasone lessens the intensity of postoperative pain and the requirement for analgesic use (pain severity reduced with $P<0.001$)
2	Patnaik et al, 2020 ¹⁰	60	Questionnaire	Random	RCT	Low	Dexamethasone does not significantly affect the outcomes of newborns and has a positive effect on the early postoperative recovery of patients undergoing CS with a delayed regression of spinal block (Apgar score at 1 min of mean \pm SD of dexamethasone was 6.97 ± 0.18 vs 6.87 ± 0.43 0.25 control group with $P=0.32$)
3	Maged et al, 2018 ¹¹	120	Questionnaire	Random	RCT	Low	The need for postoperative analgesics was significantly reduced for up to 24 hours after IV dexamethasone and local subcutaneous infiltration of the wound ($P<0.001$)
4	Shalu et al, 2017 ¹²	60	Questionnaire	Random	RCT	Low	The duration of postoperative analgesia and sensory block following cesarean section under spinal anesthesia is extended by 8 mg IV dexamethasone ($P<0.001$)
5	Mehdiratta et al, 2021 ¹³	70	Questionnaire	Random	RCT	Low	4 mg and 8 mg dexamethasone IV preoperatively for cesarean delivery under spinal anesthesia have similar effect of relieving pain, reduce the amount of opioids taken, and extend the time that anti-pain medication is administered
6	Dr.Vinutha V et al, 2019	108	Questionnaire	Random	RCT	Low	IV dexamethasone with a wide range of dose (0.1–0.2 mg/kg) preoperatively for cesarean delivery has postoperative prolongation of analgesic effect of spinal anesthesia and with minimal side effect
7	Manohar et al, 2023 ¹⁴	80	Questionnaire	Random	RCT	Low	Compared to a placebo, intravenous 8 mg dexamethasone does not extend the duration of sensory or motor block in patients undergoing LSCS under hyperbaric spinal anesthesia ($P=0.468$)
8	Cardoso et al, 2013 ¹⁵	70	Questionnaire	Random	RCT	Low	Dexamethasone reduces pain at rest and pain on movement as compared to those not taking it ($P=0.001$ at 1 h, $P=0.003$ at 6 h, $P=0.006$ at 12 h, and $P=0.01$ at 24 h postoperatively)

Administering high-dose dexamethasone intraoperatively (greater than 0.2 mg/kg) reduces postoperative pain and spares opioids. Following surgery, an effective multimodal pain management strategy is the use of intermediate dose dexamethasone (0.11 to 0.2 mg/kg), which is safe and has few side effects. Preoperative IV dexamethasone administration has a stronger impact on postoperative pain control during cesarean delivery.⁶ Furthermore, single dosage intraoperative administration of dexamethasone also decreased incidence of rebound pain by providing a considerable analgesic benefit in the early postoperative phase.⁷ Additionally administration of dexamethasone lowers 6-h pain at rest as well. Pain with movement was lower among patients who received dexamethasone at 1, 6, 12, and 24 h.¹⁵

The majority of strong studies comparing dexamethasone doses by categorizing them into three groups, low dose (0.1 mg/kg), intermediate dose (0.1–0.2 mg/kg), and high dose (more than 0.2 mg/kg), came to the conclusion that a dose of dexamethasone at 0.1 mg/kg is an efficient adjuvant in multimodal approaches to lower opioid use and postoperative pain. Depending on the complexity of the operation and the degree of tissue injury, the dexamethasone dosage may vary. In order to prevent the need for further analgesics and prolong the analgesic effects of spinal anesthesia after surgery, a wide range of doses of intravenous dexamethasone administration is required prior to cesarean delivery.^{12,18,19}

Strengths

The effectiveness of IV dexamethasone in prolongation of intrathecal anesthesia and postoperative analgesia in pregnant women who underwent cesarean section was the focus of the studies included in this review, and all studies were RCT with a high level of evidence.

Conclusion

Dexamethasone prolongs the duration of spinal block and has a positive effect on the early postoperative recovery of patients undergoing CS. The administration of single dose intravenous dexamethasone immediately after clamping of the cord at a dose of 0.1–0.2 mg/kg was effective in lowering postoperative pain, minimizing opioid consumption on the first postoperative day, extending the duration of spinal anesthesia, and delaying the need for initial analgesic medication in patients undergoing cesarean sections under spinal anesthesia.

Generally, the administration of supplemental single dose dexamethasone for non-contraindicated pregnant women who underwent cesarean section under anesthesia improves enhanced recovery from anesthesia and surgery by different aspects. That means when we make the patient pain-free the complications secondary to inability to move because of pain will be decreased.

Abbreviation

ASA, American Society of Anesthesiologists; CS, cesarean section; GCP, good clinical practice; h, hour; HUCSH, Hawassa University Comprehensive Specialized Hospital; IV, intravenous; LA, local anesthetics; LSCS, lower segment cesarean section; MA, meta-analysis; mg, milligram; mg/kg, milligram per kilogram; PICO, population, intervention, control, and outcome; PRISMA, preferred reporting items of systematic review of meta-analysis; RCT, randomized controlled clinical trials; SA, spinal anesthesia; SR, systematic review; WHO, World Health Organization.

Accessibility of Information and Resources

The corresponding author provides data upon reasonable request.

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Disclosure

The authors report no conflicts of interest in this work.

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