

Comparing the Effectiveness of Intrathecal 1% 2-Chloroprocaine with and Without Fentanyl on Quality of Subarachnoid Block in Patients Undergoing Elective Caesarean Section

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Abstract

Background: Subarachnoid block (SAB) is a safe and effective alternative to general anesthesia for lower limb surgical procedures. Preservative-free 1% 2-chloroprocaine is a short-acting local anesthetic agent suitable for daycare surgical procedures. Opioids are proven adjuvants in local anesthetics for potentiation of analgesic action.

Aims and objectives: To assess and compare the effect of intrathecal 1% chloroprocaine given with and without fentanyl as an additive on the quality of subarachnoid block in patients undergoing Elective Cesarean section.

Materials and Methods: This observational and comparative study was conducted with 96 patients with ASA status 2, aged 18 to 40, undergoing elective cesarean section (ECS) surgery under subarachnoid block. Subjects were enrolled in two groups GROUP-A includes the patients receiving 3ml 1%2-chloroprocaine with 25mcg fentanyl as an additive, and GROUP-B includes the patients receiving 3ml 1% 2-chloroprocaine without fentanyl. The duration of analgesia and time to unassisted ambulation, onset, and duration of sensory and motor blockade, the maximum height of sensory block, 2-segment regression, hemodynamic parameters, time to voiding, home discharge eligibility, and side effects were also recorded.

Results: Recorded demographic and hemodynamic parameters, the onset of sensory block, and the onset of motor block were comparable between both groups. The sensory block and analgesia duration were statistically longer in Group A than in Group B ($P < 0.0003$). The adverse effects (hypotension, bradycardia, nausea/vomiting, shivering) were comparable in both groups.

Conclusion: 2-chloroprocaine with adjuvant fentanyl prolonged the duration of sensory block and post-operative analgesia in patients undergoing ECS.

Keywords: Elective Caesarean Section, Opioids, Local Anesthetic.

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Introduction

Caesarean delivery is one of the most commonly performed surgical procedures in the obstetric population to improve maternal or fetal outcomes or to reduce anticipated complications from spontaneous labor and vaginal delivery.[1]

Regional anesthesia is a safer technique than general anesthesia in elective cesarean section (ECS) for both the mother and the baby due to its avoidance of the airway, less risk of aspiration of gastric content, and ease of administration.[2] Common complications in general anesthesia include intubation failure, ventilation failure, aspiration of gastric content, awareness, pain, and fetal depression.[3]

The subarachnoid block (SAB) technique for regional anesthesia is favored for ECS due to its simplicity, ability to provide adequate surgical anesthesia, ease of administration, faster onset of action, and safety. Other advantages include less neonatal depression, fewer complications, and a low failure rate. SAB also allows higher maternal satisfaction due to early skin-to-skin contact.[4]

Chloroprocaine is an ester-class anesthetic agent with labeled suggestions to provide anesthesia through infiltration, caudal block, epidural, and peripheral nerve. Due to its low toxicity, 2-CP has been used to identify inadvertent intravascular epidural catheter insertion in pregnant and non-pregnant adults.[5]

The most common application for 2-CP is the obstetric setting, which provides fast-onset spinal anesthesia in case of emergency cesarean deliveries. Large doses of 2-CP can be given for the longer duration of the sensory block as it has a low potential for maternal and fetal toxicity.[6]

Adding adjuvant drugs to intrathecal LA improves the quality and duration of the spinal blockade and prolongs post-operative analgesia. With the addition of an

adjuvant, it is possible to reduce the amount of LA and, thus, the incidence of side effects.

Fentanyl is a synthetic opioid, used commonly used for pain management. Intrathecal fentanyl is given as an adjuvant with other local anesthetics to increase anesthesia and analgesia. It has improved spinal anesthesia and reduced the anesthetic drug-related side effects, like pruritus, nausea, and vomiting.[6] Fentanyl is the most widely used in SAB for its potency, rapid onset, and short duration of action, with a reduced need for analgesia after the operation.[7] During this study, we aimed to evaluate and compare the effect of intrathecal 1% 2-CP given with and without Fentanyl as an adjuvant on the quality of subarachnoid block in patients undergoing ECS. [8]

Materials and Methods:

This cross-sectional observational study was conducted at the Sri Aurobindo medical college and PG Institute, Indore (MP). Ninety-six patients receiving spinal anesthesia for elective cesarean sections and fulfilling the inclusion criteria were enrolled in the study. Informed written consent was secured from the subjects after the approval of the institutional ethical committee.

Enrolled patients were divided into two groups, 48 each. GROUP A patients received 3ml 1% 2-chloroprocaine with 25mcg fentanyl, and GROUP B was given 3ml 1% 2-chloroprocaine without fentanyl as an additive during the induction of Subarachnoid Block. Inclusion criteria included the cases of patients receiving a subarachnoid block for elective cesarean sections, patients who met ASA grade 2 status, and in the age group of 18 to 40 years. Exclusion Criteria excluded the cases where patients were not given consent, emergent multiple parities (twins/ triplets), preeclampsia or eclampsia, and patients

with contraindications for spinal anesthesia (Eg-coagulopathy, pre-existing neurological defect, and cardiac disease).

Patients with known allergies to any drug, emergency procedures, failed spinal block converted to General Anesthesia, and spinal block whose effect wears off intraoperatively and needs to be supplemented with General anesthesia were excluded.

After arrival in the operation theatre, an 18-gauge (G) intravenous cannula was secured, and the parturient was preloaded with a 10 ml/kg ringer lactate solution over 15 min. Non-invasive blood pressure (NIBP), pulse oximeter, and electrocardiogram (ECG) were applied, and baseline blood pressure (BP), heart rate (HR), oxygen saturation (SpO_2), etc., were noted down. Spinal anesthesia was administered in a lateral position at the L3-4 or L4-5 interspace level using a 23 G Quincke spinal needle under aseptic precaution. The Parturient in Group A received intrathecal 1% preservative-free 2-CP 3 ml + 25 mcg fentanyl, and the parturient in Group B received intrathecal 1% preservative-free 2-CP 3 ml. After spinal anesthesia, the parturient was placed in the supine position.

The sensory and motor blockade were evaluated at 1 min, 3 min, 5 min, 10 min, 30 min, and 60 min till completion of the surgery. The sensory block was assessed by pinprick sensation using a hypodermic needle. The pinprick sensation over the clavicle was taken as a reference point. In contrast, the motor block was assessed by the modified Bromage scale (0 = no paralysis, able to flex hips/knees/ankles, 1 = able to move knees, unable to raise extended legs, 2 = able to flex ankles, unable to flex knees, 3 = unable to move any part of the lower limb) at every min till adequate sensory and motor blockade for surgery was achieved.

The onset of sensory block is defined as the time from intrathecal drug administration to

loss of pinprick sensation at the T10 level. While the onset of motor blockade considered from intrathecal drug administration to Bromage scores ≥ 2 .

The anesthesiologists recorded the NIBP, HR, SpO_2 , and VAS every 10 min in the post-operative period till the patient requested a first analgesic agent. The duration of analgesia is considered from the time of subarachnoid drug injection to the time up till the visual analog scale (VAS) for pain assessment score ≥ 4 .

The duration of the sensory block was from the onset until sensation was felt at the level of the S2 dermatome. In contrast, the duration of the motor block is from time to achieve Bromage scores ≥ 2 to time to complete recovery of motor power. Adverse events like hypotension, bradycardia, nausea, vomiting, and pruritus were recorded for the first 24 h. Paracetamol 100 ml (1 gm) i.v. was administered when VAS ≥ 4 .

Pre-designed pre-structured proforma was used for collecting the data. The data is entered into Microsoft Excel for analysis. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS). Numerical data like age, height, weight, BMI, surgery duration, and spinal block characteristics were summarised as mean \pm SD. Data on complications reported in each group were presented as numbers and percentages. An independent sample t-test was used to compare the two groups' baseline and spinal block characteristics. Fisher's exact test compared the number of complications reported between the two groups. $P < 0.05$ was considered statistically significant.

Result

The mean age of patients in Group A was 23 ± 4.2 and 26 ± 3 years in Group B, while other demographic details were similar (Table 1).

Table 1: Demographic Parameters

Demography	Group A	Group B	P value
Height (cm)	157.24±3.2	158.47±4.4	0.852
Weight (kg)	65.41±6.4	67.42±5.5	0.241
BMI (kg/m ²)	26.61±3.4	25.48±3.3	0.129

Throughout the perioperative period, HR, BP, and SpO₂ were similar in both groups ($p=0.75$). The mean time to achieve block height of T10 (onset of the sensory block) was 4.3±0.9 mins in both groups ($p=0.8$), mean time to achieve block height of T6 was 5.9±1.10 mins in group A while

5.1±0.8 mins in group B ($p=0.3$), maximum dermatomal cephalad spread in group A was 6.5±2 while in group B was 5.6±1 ($p=0.2$), the onset of motor block and the duration of motor block were comparable in both the groups [Table 2].

Table 2: Comparison of onset and duration between groups

Characteristics	Group A	Group B	P
The mean duration of sensory block in mins	103.1±15.5	74.15±11.6	<0.0002
Mean onset of motor block in mins	4.5±1.2	4.8±0.9	0.552
The mean duration of motor block in min	71.6±15.3	68.5±14.2	0.461
The mean duration of analgesia in mins	119.5±22.54	80±13.10	<0.0003

The mean duration of sensory block was prolonged in group A compared to group B; the difference is statistically significant ($P<0.0002$). The mean duration of analgesia was significantly prolonged in Group A compared to Group B; this difference is statistically significant (119.5±22.54 min versus 80±13.10min, $P < 0.0003$).

Patients were observed for adverse events in the first 24 hours after anesthesia; hypotension, bradycardia, nausea, vomiting, pruritus, and shivering were not significantly different in both groups [Table 3].

Table 3: Post-operative complications

Complication	Group A		Group B		p
	Frequency	Percentage	Frequency	Percentage	
Hypotension	3	6.25	4	8.30	0.756
Bradycardia	1	2.10	0	0	0.547
Nausea/vomiting	3	6.25	4	8.30	0.752
Shivering	4	8.30	6	12.50	0.356
Pruritus	3	6.25	0	0	0.066

Discussion

Chloroprocaine is a short-acting local anesthetic that allows rapid recovery from sensory and motor functions. The shorter duration of action is due to very low protein binding and rapid metabolism by pseudocholinesterase. Studies have shown that using preservative-free 2-CP provides a rapid and reliable sensory and motor block in doses ranging from 30–60 mg for

brief surgical procedures under subarachnoid block without significant complications.[9]

Adding adjuvants to intrathecal local anesthetics improves the quality and duration of the spinal blockade and prolongs post-operative analgesia.

Our study observed that adding 25 mcg of fentanyl to 2-CP (30 ml) for spinal

anesthesia prolonged post-operative analgesia's sensory blockade and duration. We found that the mean duration of sensory block and mean duration of analgesia were prolonged in group A compared to group B; the difference was statistically significant ($P < 0.0002$). Similar findings were reported by Singariya G et al. (2021). Another study by Uppal V et al. (2020) also highlighted the benefits of fentanyl as an additive in ECS for better pain management.

The onset of sensory block and time to achieve T6 dermatomal spread, maximum cephalad dermatomal spread, onset and duration of motor block, and adverse events were comparable in both groups. The mean time to achieve block height of T10, i.e., the onset of sensory block, and the mean time to achieve block height of T6 were comparable in both groups ($p=0.8$). Similarly, the maximum cephalad dermatomal spread, onset, and duration of the motor block were also comparable ($p=0.2$). These findings agree with Maes S et al. (2016), who observed that after 5 min of spinal injection, the level of sensory block was similar in both groups injected with 2-chloroprocaine with fentanyl and without fentanyl.[10]

Local anesthetics are toxic to various tissues and may contribute to perioperative nerve damage. Local anesthetic-induced direct nerve injury can already occur at clinical concentration levels.[11]

Safety and potential neurotoxicity issues with the preservative of 2-CP are known as the acidic solution, and the preservative bisulfite are associated with higher complications. However, preservative-free 2-CP has shown satisfactory outcomes without post-operative complications.[12]

Uses of local anesthetic agent 2-CP in low-risk ECS have been known for the reduced length of stay in the post-anesthesia care unit (PACU); this improved maternal

satisfaction due to early skin-to-skin contact and early breastfeeding.

Fentanyl has a high affinity for opioid receptors; therefore, it produces a longer duration of analgesia compared to other agents. Fentanyl can depress C-fiber reflexes, whereas the opioid local anesthetics combination results in the depression of both A δ and C-fiber mediated reflexes without efferent effect.[13]

In the present study, we administered 25 mcg of fentanyl with 3ml 2-CP. However, the time to dermatomal regression was comparable in both groups. Still, sensory regression and duration of post-operative analgesia were significantly prolonged in Group A. Study by Uppal V et al. 2020 reported that in twelve studies with 574 participants, the time to first post-operative analgesia request was longer in the intrathecal fentanyl group compared to the control group (mean difference, 91 minutes; 95% CI, 69–113; $P < .001$; $I^2 = 97\%$).

Another study by Singariya G et al. (2021) on 150 parturients who underwent cesarean sections reported similar findings where fentanyl provided a longer post-operative analgesic effect.

During this study, subjects were observed for complications in the next 24 hours post-operation, and only negligible hypotension, bradycardia, nausea, vomiting, pruritus, and shivering were recorded. This finding is in agreement with previous studies by Maes S et al. (2016) and Hejtmánek MR et al. (2011) [14]

Existing literature highlights the use of 2-CP in daycare surgeries; very few studies on 2-CP for non-daycare surgeries are available. Our study showed that 2-CP could safely be used for spinal anesthesia for low-risk LSCS. [15]

Conclusion

The present study concludes that 1% 2-chloroprocaine with fentanyl results in the

prolonged sensory blockade and post-operative analgesia compared to only 2-chloroprocaine. Both approaches result in a similar duration of motor blockade and occurrence of complications in patients undergoing elective cesarean section.

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