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Original Research Article

Sub-Anaesthetic Bolus Dose of Intravenous Ketamine for Postoperative Pain Following Caesarean Section

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Abstract:

Background: The significance of providing efficient analgesia after Caesarean Section surgery lies in the fact that parturients have an elevated susceptibility to thromboembolic events resulting from immobility. Inadequate pain treatment has been linked to an increase in the risk of postpartum depression (PPD) and disruption of the breastfeeding process. The administration of ketamine at sub-anesthetic levels has been evaluated as a potential method for mitigating postoperative pain and reducing the need for analgesics after caesarean section procedures.

Aim and Objectives: This research aimed to determine the degree to which sub-anesthetic doses of ketamine eased pain after caesarean delivery.

Material and Methods: A total of 108 pregnant women participated in a randomised, double-blind, placebo-controlled study being conducted. They were split into three groups of 36. After 5 minutes, patients in Group C received 2 ml of 0.9% normal saline, patients in Group K1 received 0.15 mg/kg of ketamine (2 ml), and patients in Group K2 received 0.3 mg/kg of ketamine (2 ml). Postoperative pain was measured using the Visual Analogue Scale (VAS), and the number of doses of rescue analgesic used within 24 hours and the occurrence of adverse events were recorded. The statistical methodology employed in this study was the use of methodology of Variance (ANOVA) for continuous variables and the Chi-square test for categorical variables. Significance was attributed to p-values that were less than 0.05.

Results: The postoperative Visual Analogue Scale (VAS) scores were found to be substantially greater in the control group. On the other hand, the time before the first analgesic was needed was significantly longer in both the K1 group (mean time of 5.44 ± 1.45 hours) and the K2 group (mean time of 6.18 ± 1.61 hours) compared with the control group (mean time of 4.97 ± 1.48 hours). The K1 group and K2 group had a considerably lower overall number of doses and total dosage of rescue analgesic (tramadol) needed during a 24-hour period, with values of 194.44 ± 53.15 mg and 152.78 ± 50.63 mg, respectively, compared to group C with a value of 136.11 ± 48.71 mg.

Conclusion: The administration of sub-anesthetic dosages (0.15 mg/kg and 0.3 mg/kg) of iv ketamine resulted in an augmentation of postoperative analgesia and a decrease in the overall intake of rescue analgesics within the initial 24 hours following caesarean section. The administration of ketamine at a dosage of 0.3 mg/kg resulted in a significant prolongation of the duration until the very first request for postoperative analgesic medication.

Keywords: Caesarean Section; Ketamine; Postoperative analgesia; Spinal anesthesia.

Introduction

The significance of providing efficient analgesia after Caesarian Section (CS) lies in the fact that individuals who have undergone this procedure are more susceptible to thromboembolic events as a result of reduced movement caused by insufficient pain management. The occurrence of intense pain during a 36-hour period following caesarean section (CS) has been correlated with a higher probability of experiencing postpartum depression (PPD) and impairs the capacity for successful

breastfeeding. [1-3] the preferred analgesic should exhibit limited transfer into breast milk in order to minimize its impact on the neonate. Also, it shouldn't cause the mother any serious side effects including bradycardia, shallow breathing, low blood pressure, nausea, vomiting, or hives. Furthermore, the analgesic should not significantly interfere with the care of the newborn or the discharge process from the hospital. [4,5] Multimodal treatment for postoperative analgesia effectively targets several pain pathways while concurrently mitigating the adverse effects associated with individual pain medications. Several pharmacological agents have been employed for the management of postoperative pain subsequent to caesarean section (CS). Among them are acetaminophen, opioids, tramadol, local anesthetics, and α-2 receptor agonists for pain relief and anti-inflammatory action. The use of analgesia without opioids is recommended during the perioperative phase in order to mitigate the occurrence of undesirable outcomes such as nausea, vomiting, pruritus, and respiratory depression. [6,7]

There is a growing literature of research suggesting that the administration of Ketamine, an antagonist of the N-methyl-D-aspartate (NMDA) receptor, has efficacy as an adjuvant in the management of postoperative pain. [8] Ketamine exhibits noncompetitive binding to the phencyclidine binding site of NMDA receptors, inducing modifications through allosteric processes and ultimately inhibiting the pain facilitation mediated by NMDA receptors.

The sustained analgesic impact of the drug, considering its short half-life and administration at sub-anesthetic dosages, is postulated to be attributed to the inhibition of central sensitization in the spinal cord. Ketamine has been seen to hinder the internalisation of opioid receptors and stimulate the activation of monoaminoergic descending inhibitory pathways at supra-spinal locations. This leads to the manifestation of anti-nociceptive effects and serves as a preventive measure against opioid-induced hyperalgesia and acute tolerance. When administered at sub-anesthetic levels, namely below 0.3 mg/kg, this substance has analgesic properties while exhibiting less noticeable psychotropic adverse effects. [9]

The 2018 consensus guidelines from the American Society of Regional Anaesthesia and Pain Medicine, the American Academy of Pain Medicine, and the American Society of Anaesthesiologists provide support for the utilization of intravenous ketamine in the management of acute pain. These guidelines recommend the administration of a sub-anesthetic bolus dose of ketamine, not exceeding 0.35 mg/kg, as well as the use of infusions up to 1 mg/kg/hour. These measures are suggested as supplementary to opioid medications for perioperative analgesia. [10] Our hypothesis posited that the inclusion of low dosage intravenous ketamine in a multimodal analgesic regimen would effectively alleviate post caesarean pain.

Aim and Objectives: The primary objective of this study was to evaluate the effectiveness of sub-anesthetic dosages of ketamine in providing analgesia following caesarean section procedures.

Material and Methods

A total of 108 pregnant women between the ages of 18 and 45 with a physical status of I or II according to the American Society of Anaesthesiologists (ASA) and scheduled to have a Caesarean Section with spinal anaesthesia participated in the research. Prior to conducting the study, approval was obtained from the Institutional Ethics Committee and written informed consent was obtained from all participants. Participants were excluded if they were pregnant and had an allergy to ketamine, had medical conditions that would have prevented them from receiving spinal anaesthesia, were using opioids chronically, or had past experiences of chronic pain.

Study design: A total of 108 individuals who had recently given birth were divided into three groups, with 36 individuals in each group. A computer-generated random number table was used for the randomization procedure, and the envelope approach was used to keep the allocation concealed. The technician in the operation room who did not participate in the medical care of the pregnant woman was in charge of making the medication solution. The individuals responsible for administering the anaesthesia and the anesthesiologist were not informed about the specific components of the solution that was provided. The administration of study medicines occurred intravenously within a 5-minute timeframe after to the delivery of the infant, following the established protocol. In this experiment, Group C was administered a 2 ml solution of normal saline with a concentration of 0.9%. On the other hand, Group K1 got a dosage of 0.15 mg/kg of ketamine, also in a 2 ml volume. Lastly, Group K2 was given a dosage of 0.3 mg/kg of ketamine, again in a 2 ml volume.

Methodology

The parturients were administered a preload of lactated Ringer's solution at a rate of 10 ml/kg after establishing intravenous access using an 18 G cannula. Prior to spinal anaesthesia, the parturients received pre-medication consisting of 50 mg of ranitidine and 10 mg of metoclopramide intravenously, administered 30 minutes beforehand. Baseline measurements of non-invasive blood

pressure (NIBP), heart rate, and SPO_2 were documented in the operation room.

The administration of spinal anaesthesia was conducted utilizing a 25-gauge spinal needle at the L3-L4/L4-L5 interspace while the patient was in a sitting posture. A total of 12.5 mg of 0.5% Bupivacaine heavy was utilized for this procedure. Following the administration of the spinal anaesthesia block (SAB), patients were promptly shifted in a supine posture, with a 15° wedge positioned beneath the right buttock in order to attain a left uterine tilt. The assessment of sensory block was conducted using the pinprick method bilaterally along the mid clavicular line, with measurements taken at one-minute intervals. Surgery was permitted after the desired block height, namely at the T6 level, was attained. The assessment of motor block was conducted using the Modified Bromage Score at one-minute intervals. Oxygen was given using a basic face mask at a flow rate of 4 liters per minute. Hemodynamic parameters, including heart rate (HR), systolic blood pressure (BP), diastolic blood pressure (BP), mean arterial pressure (MAP), and peripheral oxygen saturation, were observed and recorded at specific time intervals of 2, 4, 6, 8, 10, 15, and 20 minutes subsequent to the administration of spinal anaesthesia. Hypotension was operationally defined as a decrease in mean arterial pressure (MAP) exceeding 20% below the baseline value before to anaesthesia administration. In response to this condition, a therapeutic intervention was implemented, consisting of the administration of a 100 ml intravenous fluid bolus and 5 mg of ephedrine. Bradycardia was operationally defined as a heart rate (HR) below 50 beats per minute (bpm) and thereafter managed with the administration of intravenous (IV) atropine at a dosage of 0.6 mg. The administration of the study medicine occurred intravenously, precisely 5 minutes following the delivery of the infant, in accordance with the assigned group. The APGAR score was assessed for all newborns at both 1 and 5 minutes. Following the end of surgery, each patient was administered a 100 mg suppository of Diclofenac Na.

The assessment of postoperative pain was conducted using the Visual Analogue Scale (VAS), which measures pain on a scale of 0 to 10, with 0 indicating the absence of pain and 10 representing the most severe agony imaginable. Pain levels were examined at certain time intervals, namely 2, 6, 10, 12, and 24 hours after the procedure. In cases where the VAS score was equal to or more than 4, a rescue analgesic in the form of intravenous tramadol at a dosage of 100 mg was administered. Scientists tracked how long it took before patients asked for painkillers after receiving intrathecal injections of anaesthetic solutions. They recorded how many doses of analgesic were given and how much was taken over the course of 24 hours. The levels of postoperative sedation were assessed at various time points (immediately after surgery, 2 hours, 4 hours, and 6 hours later) using the Ramsey Sedation Score, which categorizes sedation levels as follows: 1 = cooperative and oriented, 2 = responsive only to commands, 3 = exhibiting a brisk response to a light glabellar tap or loud noise, 4 = displaying a sluggish response to a light glabellar tap or loud noise, and 5 = showing no response.

The incidence of postoperative nausea and vomiting (PONV) and pruritus during the initial 24-hour period subsequent to caesarean section (CS) was documented and managed with Ondansetron at a dosage of 4 mg and dexamethasone at a dosage of 8 mg, respectively. Concerns of postoperative unsettling dreams were documented for duration of 72 hours after the completion of the surgical procedure, namely caesarean section (CS). These concerns were addressed by administering intravenous midazolam at a dosage of 1 mg. The patient's satisfaction level was assessed 24 hours post-treatment, categorized as excellent, satisfactory, or non-satisfactory.

Sample size calculation: Assuming an alpha error of 5% and a beta error of 20%, corresponding to a confidence level of 95% and a power of 80% for the research, we made the assumption that the proportion of the exposed group was 95%, with a margin of error of 10%. To meet this requirement, a total of 108 patients were randomly assigned to one of three groups (n = 36 in each).

Statistical analysis: The statistical analysis was conducted using SPSS software (version 17, SPSS, Chicago, IL). The data was presented using proper statistical measures, such as the mean, standard deviation, median (range), or percentage. The statistical technique of analysis of variance (ANOVA) was employed to determine the significance of differences among three groups of parturients in relation to continuous variables. Additionally, a paired t-test was utilized to compare the differences between groups. The chi-square test was employed to determine the statistical significance of the research parameters on a categorical scale. Statistical significance was determined by considering p-values that were less than 0.05.

Results

A total of 108 parturients were included in the investigation. There were no statistically significant differences seen among the three groups in terms of demographic variables such as age, weight, height, and gestation week, as well as in the spinal to incision time and duration of operation. The null hypothesis is not rejected at a significance level of

0.05. The APGAR score at 1 and 5 minutes was found to be similar among the three groups (P > 0.05) due to the intravenous administration of ketamine 5 minutes after the baby's delivery. **[Table 1]**

Table 1: Demographic variables

Variables	Group C (n=36) (Mean±SD)	Group K1 (n=36) (Mean±SD)	Group K2 (n=36) (Mean±SD)	P- value
Age (years)	29.57±3.82	29.59±4.39	29.1±5.61	>0.05 (NS)
Weight (kgs)	71.48±4.47	72.09±3.61	71.26±4.08	>0.05 (NS)
Height (cms)	157.45±3.35	156.93±3.37	156.82±3.33	>0.05 (NS)
Gestation week	37.26±0.45	37.23±0.55	37.29±0.46	>0.05 (NS)
Spinal to incision time (mins)	3.98±0.77	3.93±0.74	3.95±0.68	>0.05 (NS)
Duration of surgery (mins)	38.18±5.24	38.62±5.28	38.07±4.68	>0.05 (NS)
APGAR score at 1 min	8.53±0.52	8.26±0.45	8.54±0.52	>0.05 (NS)
APGAR score at 5 min	8.93±0.29	8.63±0.48	8.76±0.45	>0.05 (NS)

NS- Not Significant

There was no statistically significant variation in the average arterial pressure (MAP) and heart rate (HR) during the surgical procedure at various points in time among the three groups.

The occurrence of hypotension and the need for ephedrine were determined to lack statistical significance.The postoperative Visual Analogue Scale (VAS) score exhibited a high level of statistical significance among the three groups at the 2-hour mark (P < 0.001). Additionally, there was a statistically significant difference in VAS score between the groups at the 10-hour and 12-hour marks (P < 0.05). However, no statistically significant difference in VAS score was seen at the 6-hour and 24-hour marks among the three groups (P > 0.05). **[Figure 1]**

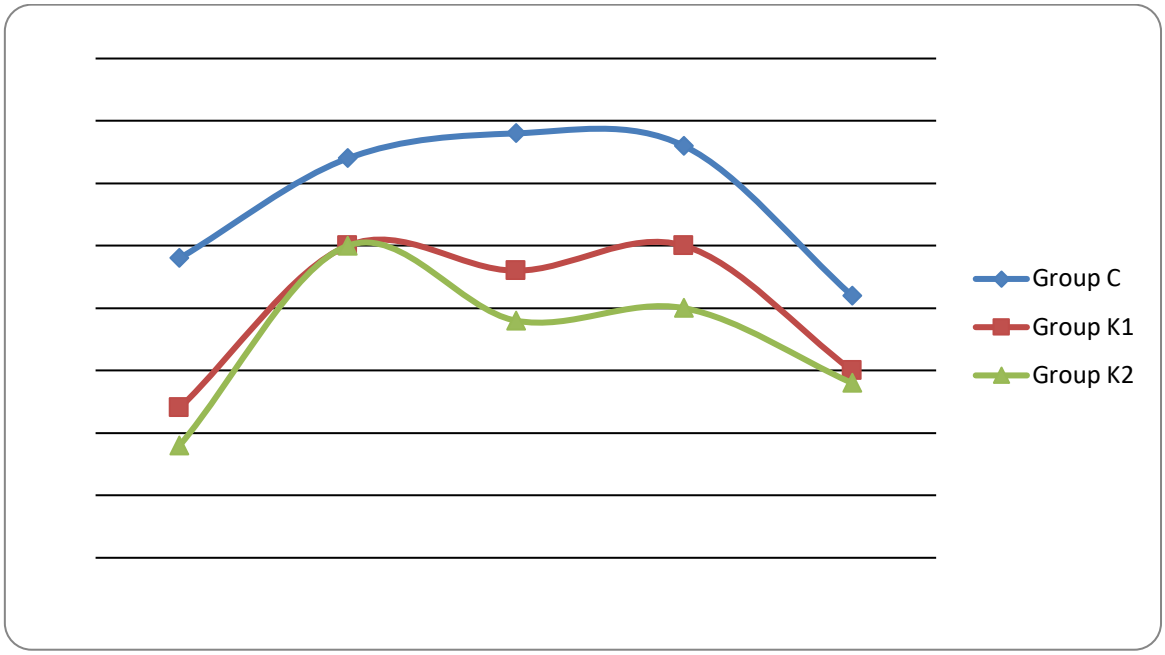

Figure 1: VAS score at different time intervals among the groups

The duration until the first administration of analgesic medication (in hours) was seen to be extended in both the K1 group (5.44 ± 1.45) and the K2 group (6.18 ± 1.61) when compared to the control group (4.97 ± 1.48). This difference was determined to be of statistical significance (P < 0.05). **[Figure 2]**

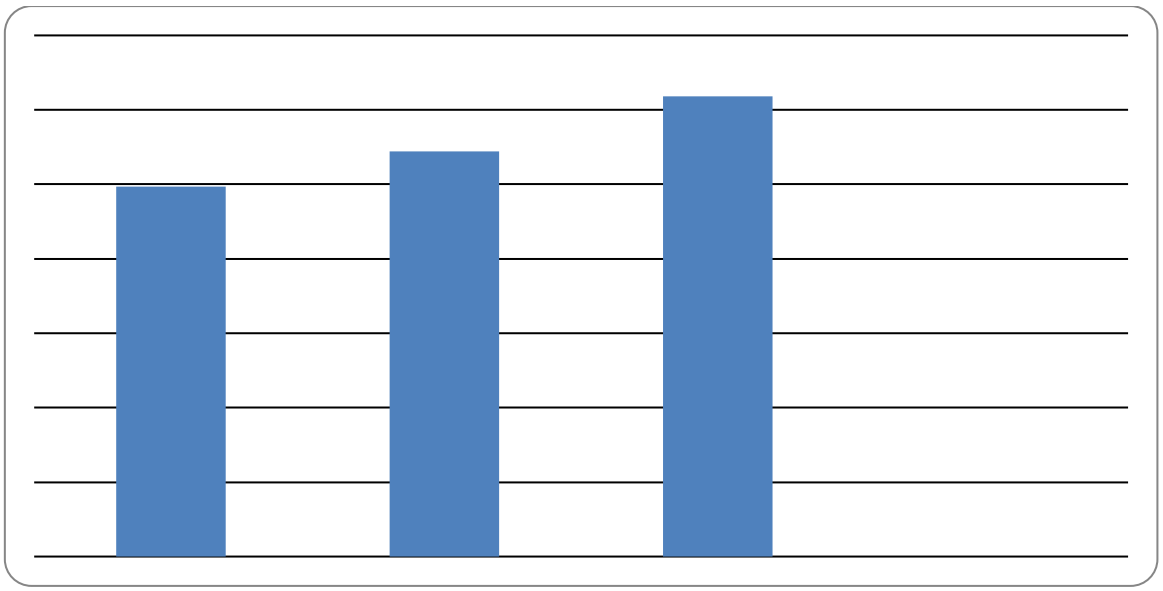

Figure 2: Time (hrs) to first analgesic demand among groups

The K1 and K2 groups exhibited a significantly lower overall number of dosages and total dosage of rescue analgesic needed during a 24-hour period compared to group C, with a high level of statistical significance (P < 0.001). However, when comparing the K1 and K2 groups, a statistically significant difference was seen just in the time taken for the first analgesic demand (P = 0.045). **[Table 2]**

Table 2: Comparison of postoperative rescue analgesic (Tramadol) requirement

Variables	Group C (n=36) (Mean±SD)	Group K1 (n=36) (Mean±SD)	Group K2 (n=36) (Mean±SD)	P- value
Time to first analgesic demand (hrs)	4.98±1.49	5.45±1.46	6.19±1.62	<0.05 (S)
Total number of doses of rescue analgesic in 24 hrs	1.95±0.54	1.54±0.52	1.37±0.48	<0.001 (S)
Total dose of rescue analgesic (mgs) in 24 hrs	194.45±53.16	152.79±50.64	136.12±48.72	<0.001 (S)

S- Significant

The control group had a higher prevalence of nausea and vomiting (75%) in comparison with both the K1 (66%) & K2 (52.17%) groups, however this difference was not of statistical significance (P = 0.14).

The prevalence of pruritus was found to be substantially higher in group C (25%) in comparison with both groups K1 (2.7%) & K2 (8.3%) (P = 0.01).

In a span of 24 hours, a mere two patients from the K2 group reported experiencing unsettling bad dreams. [Table 3] The study observed that two patients (5.5%) in group K1 & seven patients (19.4%) in group K2 had outstanding satisfaction scores after 24 hours. All patients in group C (100%) reported a satisfactory score, but 94.4% of patients in group K1 (34 patients) and 80.5% of patients in group K2 (29 patients) stated the same.

None of the patients in the three groups reported non-satisfactory score. [Table 3]The analysis revealed that there was no statistically significant difference in sedation scores among the three groups at various time intervals (P > 0.05). [Table 3]

Table 3: Postoperative side-effects, Satisfaction score, Sedation score

Variables		Group C (n=36) (Mean±SD)	Group K1 (n=36) (Mean±SD)	Group K2 (n=36) (Mean±SD)	P- value
Nausea & Vomiting		14 (38%)	9 (25%)	7 (19.4%)	0.14 **(S)**
Pruritus		9 (25%)	3 (8.3%)	1 (2.7%)	0.01 **(S)**
Disturbing dreams	24 hrs	0	0	2 (5.5%)	-
	48 hrs	0	0	0	
	72 hrs	0	0	0	
Satisfaction	Excellent	0	2 (5.5%)	7 (19.4%)	-

score	Satisfactory	36 (100%)	34 (94.4%)	29 (80.5%)	
	Non-satisfactory	0	0	0	
Sedation score	After completion of surgery	1.0	1.03±0.22	1.06±0.24	>0.05 (NS)
	2 hrs	1.0	1.0	1.0	>0.05 (NS)
	4 hrs	1.0	1.0	1.0	>0.05 (NS)
	6 hrs	1.0	1.0	1.0	>0.05 (NS)

NS- Not Significant, S- Significant

Discussion

In addition to its effects on opioid receptors, muscarinic receptors, monoaminergic receptors, and -aminobutyric acid receptors, ketamine's analgesic activity in acute pain is mediated by its reversible antagonism of N-methyl D-aspartate receptors. In addition, ketamine has very little psychomimetic effects. [11,12] Multiple studies have documented that the administration of intravenous ketamine at modest doses (equal to or less than 0.3 mg/kg) is efficacious in diminishing the need for analgesics within the initial 24 hours following surgical procedures. [13-15]

In the present investigation, it was observed that patients belonging to group C had a greater degree of postoperative pain, as evidenced by substantially elevated Visual Analogue Scale (VAS) ratings at 2 hours, 10 hours, and 12 hours post-surgery ($P < 0.05$). Previous studies have indicated that the ketamine groups exhibit lower scores on the Visual Analogue Scale (VAS), which is associated with several benefits including enhanced early maternal-child attachment and the commencement of breastfeeding at an earlier stage.[13] In a similar vein, Rahmanian M et al. [16] demonstrated elevated postoperative Visual Analogue Scale (VAS) scores at 1 hour, 2 hours, 6 hours, and 12 hours in the control group. Similarly, Menkiti ID et al. [13] observed greater postoperative VAS scores in the control group up to 150 minutes. Additionally, Sen S et al. [14] reported higher VAS scores at 90 minutes, 150 minutes, and 180 minutes in the control group. In contrast to the findings of our study, Bauchat JR et al. [17] did not observe any statistically significant differences in the Numeric Rating Scale (NRS) scores between the two groups during the initial 24-hour period following surgery. This lack of significant difference may be attributed to the implementation of a multimodal analgesic regimen in their study, which involved the administration of fentanyl (15 µg) and morphine (150 µg) intrathecally in addition to 12 mg of hyperbaric Bupivacaine during spinal anaesthesia. Furthermore, all patients in their study received a standard postoperative analgesic regimen, which included scheduled intravenous administration of Ketorolac (30 mg) every 6 hours for duration of 24 hours. Similarly, the studies conducted by Han SY et al. [18] and Suppa E et al. [19] did not demonstrate any statistically significant disparities in postoperative Visual Analogue Scale (VAS) ratings. This lack of significant differences may be attributed to the administration of opioids as rescue analgesics using patient-controlled analgesia (PCA) devices at regular intervals in both study groups.

The study observed a significant difference in the duration of time until the first demand for rescue analgesic medication after surgery among the K2 group (6.18 ± 1.61 hours), the K1 group (5.44 ± 1.45 hours), and the control group (4.97 ± 1.48 hours), with a p-value less than 0.05. In our research, we observed that the amount of rescue analgesic (specifically tramadol 100 mg) used within 24 hours after surgery was considerably reduced in both the K2 group (136.11 ± 0.49 mg) and the K1 group (152.78 ± 50.63 mg) in comparison with the control group (194.44 ± 53.15 mg). The statistical significance of the observed results is indicated by a p-value of less than 0.001. In a similar vein, Menkiti et al. [13] discovered that the average duration until the first dose of postoperative analgesics was extended by an average of 44 minutes in the ketamine group. Additionally, the consumption of postoperative Diclofenac and Pentazocine was reduced in the ketamine group. In a study conducted by Sen et al. [14], it was demonstrated that the duration until the initial call for postoperative analgesia was much longer in the group administered with ketamine, with a mean difference of 30 minutes. Additionally, there was a reduction in the 24-hour intramuscular Diclofenac needs in this group. In their study, Rahmanian et al. [16] observed a significant increase in the time to initial analgesic request by 80 minutes among participants in the ketamine group. The significantly extended period of pain relief observed in this study can be attributed to the combined impact of intraoperative administration of ketamine, which enhances postsynaptic NMDA receptor blockade, thereby reducing wind-up as well as central sensitization, and the use of morphine, which inhibits presynaptic opioid receptors, thereby reducing afferent transmission. These interventions were included in the postoperative analgesic regimen. [20] In contrast, the study conducted by Bauchat et al. [17] did not demonstrate any statistically significant disparity in the duration until the initial request for further analgesics and the overall quantity of analgesics required between the two groups. This lack of distinction may be attributed to the administration of ketamine subsequent to the birth of the fetus,

perhaps resulting in the sensitization of NMDA receptors prior to the administration of ketamine. The increased analgesic needs observed in some patient groups in Western populations, together with the utilization of a multimodal analgesic approach in their investigation, may have obscured the little analgesic advantage associated with low-dose ketamine. In a study conducted by Han et al. [18], it was observed that no significant difference was found in the need for postoperative analgesia. In their investigation, the authors utilized fentanyl for patient-controlled analgesia (PCA) in all subjects up to 48 hours following the surgical procedure.

Research findings have provided evidence indicating that the occurrence of postoperative pain can be attributed to the combined effects of peripheral & central sensitization mechanisms. [21] After the initiation of surgical incision, cutting, and traction, the activation of free nerve terminals occurs. This leads to the release of chemical pain mediators such as bradykinin and prostaglandin, which contribute to the prolonged experience of pain. Consequently, primary hyperalgesia is established. The occurrence of secondary hyperalgesia is triggered by peripheral sensitization, which is characterized by the facilitation of A-α and A-β nerve fibers. Given that chemical mediators persistently release after the first insult, it is imperative to inhibit their effects for a period greater than that of a single dosage of given analgesia. Clinical trials involving the administration of low-dose ketamine have indicated various mechanisms that contribute to its analgesic properties. These include the inhibition of central sensitization, the avoidance of developing a tolerance to opioids, and the activation of monoaminergic descending inhibitory pathways at supra-spinal locations. Dorsal root neurons increase their spontaneous neuronal activity and reactivity, a condition known as central sensitization. [10] The administration of a low dosage of intravenous ketamine in our research may have potentially mitigated discomfort and postponed the initiation of central sensitization. The observed impact of ketamine may potentially arise from its antagonistic activity on spinal NMDA receptor locations, as well as its interaction with several opioidergic as well as cholinergic receptor subtypes.

All patients within the control group exhibited a Ramsey sedation score of one following the conclusion of the surgical procedure, as well as at 2 hours, 4 hours, and 6 hours postoperatively. In contrast, a single patient (2.7%) in group K1 along with 2 patients (5.5%) in group K2 experienced mild sedation (Ramsey sedation score 2) immediately after the surgery. Furthermore, none of the patients in either of the ketamine groups scored higher than two on the Ramsey sedation scale during the other time intervals. In a study conducted by Menkiti ID et al. [13], it was shown that 3 (9%) patients had moderate drowsiness. Similarly, Sen et al. [14] observed mild sedation in just two patients (6.6%). Ebong EJ et al. [15] observed a highest Ramsey sedation score of 2 in the ketamine group, which was likely attributed to the central nervous system depressant action of ketamine. In a study conducted by Bauchat et al. [17], the authors evaluated the level of sedation using the Richmond agitation-sedation scale at 5 minutes after the administration of the study drug. They found that the ketamine group exhibited significantly higher levels of restlessness and drowsiness compared to the saline group ($P = 0.03$). Additionally, 35% of patients in the ketamine group reported experiencing symptoms such as light-headedness, dizziness, and double vision, whereas only 8% of patients in the saline group experienced these symptoms. It is important to note that these symptoms were transient and occurred solely during the infusion period, with no lasting effects observed postoperatively.

In our study, we observed a greater likelihood of postoperative nausea and vomiting (PONV) in the control group (38%) compared to the K1 (25%) and K2 (19.4%) groups. However, the difference in incidence between the groups was not statistically significant ($P = 0.14$). On the other hand, we found that the total dose of intravenous Ondansetron needed for PONV in the first 24 hours after surgery was significantly lower in the ketamine groups ($P < 0.05$). This could be attributed to the reduced need for rescue analgesic (tramadol 100 mg IV) in the K2 group compared to the K1 and control group. Several studies, including Rahmanian et al. [16], Reza et al. [17], Haliloglu et al. [22], and Bauchat et al. [17], have found no statistically significant differences in the incidence of nausea & vomiting among the group receiving ketamine and the control group.

In the present investigation, the prevalence of pruritus was found to be considerably higher in the control group (25%) compared to the K1 (8.3%) & K2 (2.7%) groups. These findings are consistent with the results reported by Rahmanian M et al. [16] The reduced occurrence of unsettling dreams in our research might perhaps be elucidated by the administration of sub-anesthetic quantities of ketamine. In a similar vein, Bilgen et al. [23] discovered that within the ketamine group, only one patient reported experiencing postoperative hallucination. Conversely, Menkiti et al. [13] and Haliloglu et al. [22] observed that no patients in either group displayed psychomimetic phenomena. Rahmanian et al. [16] demonstrated a higher incidence of hallucinations among the ketamine group. The observed variations in the outcomes might potentially be attributed to

variances in anaesthesia type, sample size, ketamine dosage, and timing of ketamine administration.

Limitations of the study: Our study is subject to several limitations. The effectiveness of sub-anesthetic dosages of ketamine for preemptive analgesia could not be evaluated. Central sensitization was not assessed in our study, as pain levels were only recorded during the early postoperative period, namely up to 24 hours after the surgical procedure. The investigation did not yield conclusive evidence on the potential impact of ketamine on various pain components, such as global pain ratings. The investigation of antidepressant effects during the postpartum period was not included in our study. Further research can be conducted in the future to investigate the potential mood-altering effects of ketamine and its impact on persistent post caesarean section pain.

Conclusion:

In our study, we observed that the administration of two distinct sub-anesthetic doses (0.15 mg/kg and 0.3 mg/kg) of intravenous ketamine resulted in improved postoperative analgesia for women undergoing caesarean section under spinal anaesthesia. These effects were achieved without any notable adverse effects. Furthermore, the total amount of rescue analgesics required within the initial 24 hours following the procedure was reduced. Additionally, the higher dose of 0.3 mg/kg IV ketamine provided an additional advantage by prolonging the time until the first request for postoperative rescue analgesics.

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