Am J Transl Res 2026;18(2):1287-1297
www.ajtr.org /ISSN:1943-8141/AJTR0169353

Original Article

Single low-dose esketamine improves postpartum depression symptoms and recovery quality in cesarean section women

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Received October 16, 2025; Accepted January 22, 2026; Epub February 15, 2026; Published February 28, 2026

Abstract: Objective: To investigate the effects of single low-dose esketamine combined with patient-controlled intravenous analgesia (PCIA) on early postpartum depression symptoms and recovery quality in women undergoing cesarean section. Methods: This prospective, randomized, controlled study enrolled 136 women scheduled for elective cesarean section, who were randomly assigned in a 1:1 ratio to the study group (esketamine group, n=68) or the control group (placebo group, n=68). In the study group, esketamine (0.2 mg/kg) was intravenously infused for 40 minutes immediately after fetal delivery. In the control group, an equal volume of normal saline was given. Both groups then received PCIA for pain relief maintenance after the operation. The Edinburgh Postnatal Depression Scale (EPDS) scores, Obstetric Quality of Recovery-10 (ObsQoR-10) scores, and postoperative recovery indicators were compared between groups at different time points after surgery. Results: Compared with the control group, the study group showed significantly lower EPDS scores at postoperative days 2 and 7, higher ObsQoR-10 scores, shorter times to first ambulation, flatus, and breastfeeding, as well as increased breastfeeding frequency within 48 hours (all $P<0.05$). The incidence of adverse reactions revealed no statistically significant difference ($P>0.05$). Conclusion: A single low-dose esketamine combined with PCIA effectively alleviates early postpartum depression symptoms, enhances postoperative recovery in women undergoing cesarean section, and demonstrates good safety and clinical applicability.

Keywords: Low dose, esketamine, cesarean section, postpartum depression, patient-controlled intravenous analgesia

Introduction

Perinatal depression is one of the most common mental disorders in perinatal women and can have long-term negative effects on maternal and infant health if severe. A cross-sectional study found that approximately 6% to 13% of women in developed countries may experience depression symptoms during the perinatal period [1]. Studies by Dadi et al. indicate an incidence of 21% in middle-income countries and up to 26% in low-income countries [2]. The clinical manifestations of perinatal depression are diverse, including low mood, anxiety, poor concentration, and feelings of worthlessness, and severe cases may involve psychosis or suicidal thoughts [3]. Research shows that about 20% of perinatal depression patients are affected by suicidal ideation [2]. Postpartum depression not only harms the health of the mother but also affects the mother-infant relationship and family structure. Research also indicates an independent and significant association between maternal depression and preterm birth, with potential adverse effects including fetal growth restriction, low birth weight, feeding difficulties, and long-term cognitive and behavioral problems [4, 5]. Currently, common interventions include psychotherapy and pharmacotherapy. Medications such as selective serotonin reuptake inhibitors (SSRIs), benzodiazepines, and adjunctive antipsychotics are effective but, due to their slow onset and safety concerns, are inadequate for meeting the needs of short-term postoperative mood interventions in mothers [6].

https://doi.org/10.62347/EUOK7911

In recent years, ketamine has attracted attention for its use in treatment-resistant depression due to its rapid onset and unique mechanism of action [7]. Clinical studies indicate that a 0.5 mg/kg intravenous injection of ketamine can improve depressive symptoms with in a few hours, with effects lasting approximately one week [8]. However, due to its potential for tolerance and addiction, repeated injections still pose safety risks. Its S-enantiomer, esketamine, has a stronger binding affinity to N-methyl-D-aspartate (NMDA) receptors and has been shown to upregulate neurotrophic factors such as brain-derived neurotrophic factor (BDNF), producing rapid antidepressant effects [9]. Consequently, single intraoperative use of esketamine as an early intervention strategy has become a current research focus. Studies by Ma and colleagues have shown that adding esketamine to postoperative analgesic pumps can effectively relieve pain and reduce the incidence of postpartum depression after cesarean section [10]. Similarly, a recent randomized controlled trial published by Wang and colleagues in the BMJ also demonstrated that immediate postpartum infusion of 0.2 mg/kg esketamine can reduce the risk of postpartum depression at 42 days, suggesting its potential application in postpartum mood management [11].

However, most current studies focus on high-risk mothers with a history of depression or those affected by postoperative pain, thus research lacks systematic validation for the general maternal population. This study aims to observe the effect of intravenous infusion of 0.2 mg/kg esketamine administered immediately after fetal delivery on early mood in mothers undergoing elective cesarean section through a prospective randomized controlled trial, and to assess its intervention effects under different mood conditions, with the aim of providing clinical evidence for precise postpartum depression prevention strategies.

Materials and methods

Patients and ethical statement

A total of 136 women scheduled for elective cesarean section were enrolled in this study and randomly assigned in a 1:1 ratio to the study group (esketamine group, n=68) or the control group (normal saline group, n=68) using a random number table.

This prospective, randomized controlled trial (Chinese Clinical Trial Registry: ChiCTR2400088992) was conducted at Dongguan Maternal and Child Health Hospital between August 2024 and August 2025. The study protocol was approved by the ethics committee of the Dongguan Maternal and Child Health Hospital. Written informed consent was obtained from all participants prior to enrollment. This study was carried out in accordance with the Declaration of Helsinki and the Good Clinical Practice guidelines.

Participant recruitment

Inclusion criteria were: (1) ASA physical status I-II; (2) full-term singleton pregnancy (≥37 weeks); (3) age 18-60 years; (4) body mass index (BMI) between 18 and 35 kg/m^2; (5) elective surgery with duration <2 hours; and (6) signed informed consent and voluntary participation.

Exclusion criteria were: (1) contraindications to neuraxial puncture or failed neuraxial anesthesia; (2) long-term use of analgesic, sedative, or anxiolytic medications; (3) pre-pregnancy comorbidities such as hypertension, diabetes, or thyroid dysfunction; (4) history of allergy to the involved drug; (5) communication barriers, cognitive impairment, or psychiatric disorders; and (6) any other conditions deemed unsuitable for participation by the investigators.

Randomization and blinding

All study subjects began receiving intravenous infusion immediately after delivery. The study group was administered 0.2 mg/kg of esketamine. Firstly, the esketamine infusion was prepared strictly according to medical orders and introduced via a three-way stopcock into an established peripheral venous access. Subsequently, the drug was continuously infused using a controllable-rate spring pump, and the infusion pump was properly secured to the patient's forearm. During infusion, the patient's vital signs and analgesic effects were closely monitored, and attention was paid to any adverse reactions such as dizziness, nausea, or hallucinations to ensure medication safety and the stability of analgesic effect. The infu-

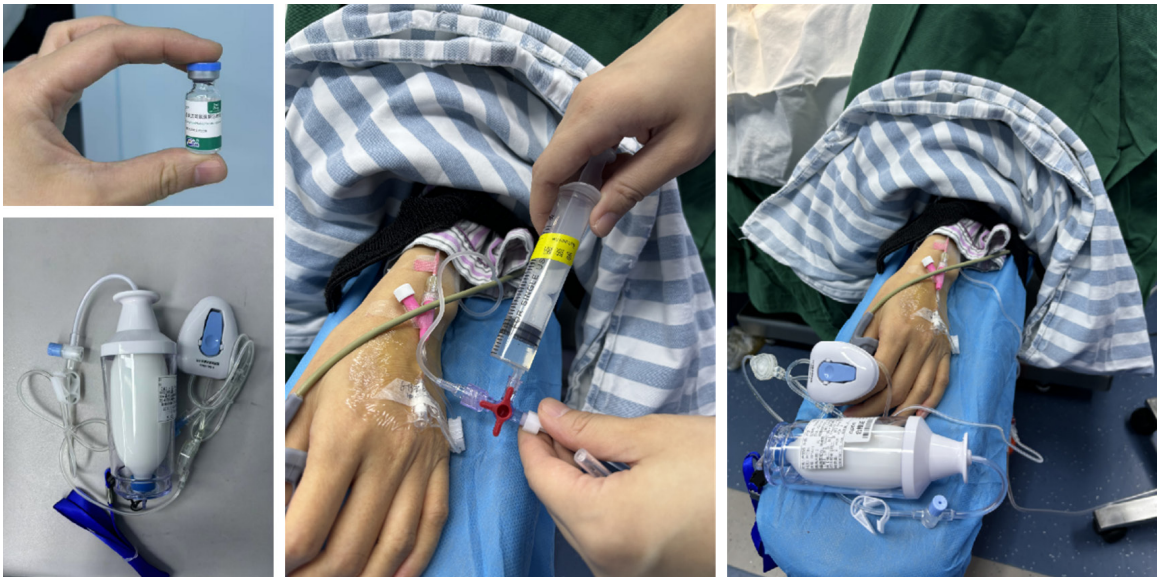

Figure 1. Infusion process of esketamine.

sion process is shown in **Figure 1**. The control group received an equal volume of saline, both infused over 40 minutes. This study employed a single-blind design, where the mothers were unaware of the treatment received, while the attending anesthesiologists were informed of the grouping and carried out the procedure.

Anesthesia and surgical procedure

Both groups of patients did not use sedatives or analgesics preoperatively. After entering the operating room, a peripheral venous line was established, and routine monitoring of non-invasive blood pressure, heart rate, and pulse oxygen saturation was conducted, with oxygen administered via mask (2 L/min). Anesthesia was performed using combined spinal-epidural anesthesia by an experienced anesthesiologist, with 0.75% ropivacaine injected into the subarachnoid space (dose adjusted according to height) and an epidural catheter left in place 3-5 cm. Postoperative analgesia regimen consisted of butorphanol tartrate 10 mg, flurbiprofen ester 200 mg, and dexamethasone 10 mg, prepared into 100 mL and delivered using a PCIA pump with a regimen of 2 mL/h baseline infusion, with patient-controlled additional 1 mL doses every 20 minutes. If postoperative analgesia was inadequate, flurbiprofen ester 50 mg could be added by intravenous push.

Intervention protocol

The study drug was administered intravenously immediately after the delivery of the fetus and umbilical cord ligation, with infusion time set uniformly at 40 minutes. The study group received esketamine (0.2 mg/kg), with the specific infusion procedure and medication shown in **Figure 1**, while the control group received an equal volume of normal saline. Routine fluid supplementation was administered during surgery, with preloading of 6 mL/kg colloid solution before surgery. If intraoperative systolic blood pressure fell by more than 20% from baseline or <90 mmHg, intravenous phenylephrine 50-100 μg was given; if heart rate <50 beats/min, atropine 0.3-0.5 mg was administered.

Outcome measures

The primary endpoints were Edinburgh Postnatal Depression Scale (EPDS) scores on the 2nd and 7th day postpartum. Secondary endpoints include: ① Quality of recovery scores (ObsQoR-10) at 24 h and 48 h postpartum; ② Pain scores at 24 h postpartum at rest and during movement (Visual Analogue Scale, VAS); ③ Length of hospital stay; ④ Discharge satisfaction (total score 10); ⑤ Adverse events within 24 h postoperatively, including tachycardia, hypertension, respiratory depression, nausea, vomiting, dizziness, agitation, hallucinations,

Table 1. Comparison of general data

Variable	Study group (n=68)	Control group (n=68)	t/χ^2	P
Age (years)	31.8±4.1	31.7±4.2	0.15	0.88
Height (cm)	159.62±4.34	160.27±5.15	0.796	0.428
Weight (kg)	68.64±10.17	67.82±9.44	0.487	0.627
BMI (kg/m^2)	27.21±3.42	26.95±3.17	0.460	0.646
Gestational weeks (weeks)	38.15±0.97	38.34±0.86	1.209	0.229
Operation time (min)	45.32±15.24	44.82±14.75	0.194	0.846
Prenatal WBC ($\times 10^9/L$)	8.22±2.05	8.15±1.94	0.205	0.838
Prenatal N ($\times 10^9/L$)	6.22±1.74	6.16±1.65	0.206	0.837
NLR	4.33±1.45	4.25±1.34	0.334	0.739
PPT-T0 (kg)	0.73±0.34	0.71±0.27	0.380	0.705
PTO-T0 (kg)	1.85±0.66	1.92±0.75	0.578	0.564
Gestational diabetes mellitus, n (%)	15 (22.06%)	14 (20.59%)	0.044	0.834
Hypothyroidism, n (%)	8 (11.76%)	9 (13.24%)	0.067	0.796
Hypertension, n (%)	3 (4.41%)	4 (5.88%)	0.151	0.698
Hyperproteinemia, n (%)	2 (2.94%)	3 (4.41%)	0.208	0.649
History of cesarean section, n (%)	30 (44.12%)	28 (41.18%)	0.120	0.729

Note: WBC, White Blood Cell Count; N, Neutrophil Count; NLR, Neutrophil-to-Lymphocyte Ratio; PPT-T0, Pressure Pain Threshold at Baseline; PTO-T0, Pain Tolerance Threshold at Baseline.

diplopia and other symptoms; ⑥ Neonatal NICU admission rate.

Safety assessment

Close monitoring of adverse events within 24 h postoperatively, including heart rate, blood pressure, respiration, and consciousness. All adverse events are recorded with their severity and drug-relatedness. Serious adverse events were reported to the ethics committee within 24 hours and a serious adverse event report form was completed.

Statistical analysis

Statistical analyses were performed using SPSS 22.0. Continuous variables with normal distribution were expressed as mean ± standard deviation ($\bar{x} \pm s$) and compared between groups using independent t-tests. Non-normally distributed data are presented as median (IQR) and compared using the Mann-Whitney U test. Categorical data were presented as n (%) and compared between groups using the χ^2 test or Fisher's exact test. For multi-time point or repeated measurement indicators, repeated measures ANOVA or two-way ANOVA were used. Bonferroni post hoc tests were conducted when differences were significant. $P<0.05$ was considered statistically significant.

Results

Comparison of clinical data

No statistically significant differences were observed between the two groups in terms of age, height, weight, body mass index, gestational age, operative time, preoperative leukocyte count, neutrophil count, neutrophil-to-lymphocyte ratio (NLR), preoperative pressure pain threshold, or pain tolerance threshold (all $P> 0.05$). These findings indicate good baseline comparability between the two groups (**Table 1**).

Comparison of postpartum depression (PPD) incidence

On postoperative days 3, 7, 14, and 30, both the groups showed a decreasing trend in the incidence of PPD. Among them, the difference between the two groups was most significant on postoperative day 3, with 4 cases (5.88%) of PPD in the study group, significantly lower than 15 cases (22.06%) in the control group ($\chi^2=7.403$, $P=0.007$). In addition, on postoperative days 7 and 14, the incidence of PPD in the study group was also lower than that in the control group, at 5.08% vs. 22.41% ($\chi^2=5.445$, $P=0.020$) and 5.08% vs. 20.69% ($\chi^2=5.096$, $P=0.024$), respectively. On postoperative day

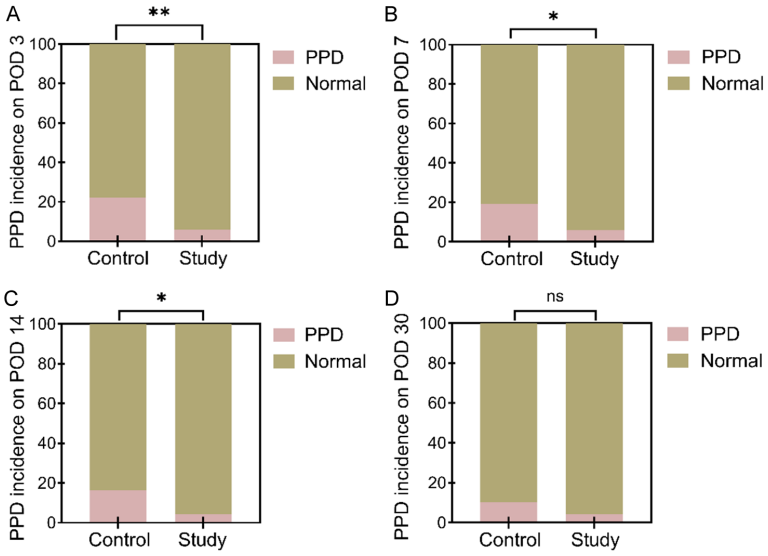

Figure 2. The incidence of PPD in parturients undergoing cesarean section at (A) 3, (B) 7, (C) 14 and (D) 30 days after the operation. Compared with the control group, *P<0.05; **P<0.01; ns, P>0.05. PPD, postpartum depression.

30, the difference between the two groups was not statistically significant (χ^2=1.727, *P*= 0.189). This suggests that esketamine intervention can significantly reduce the incidence of early postpartum PPD (especially within the first two weeks after surgery) and has a good preventive antidepressant effect. See **Figure 2**.

Comparison of postoperative EPDS scores

On the 2nd and 7th days postpartum, the EPDS scores of the mothers in the study group were lower than those of the control group (all P<0.05), suggesting that the intervention had benefits in alleviating early postpartum depression moods. On the 2nd day postpartum, the scores of both groups were high in sub-items such as “feeling happy”, “feeling optimistic about the future”, “feeling anxious or worried”, “feeling self-blame”, and “feeling sad or distressed”, but the overall score of the study group was significantly lower than that of the control group. Particularly in core emotional items such as “feeling anxious or worried”, “feeling fear without reason”, and “having thoughts of self-harm”, “the study group scored lower”, indicating that the intervention helped relieve negative emotions. By the 7th day postpartum, EPDS scores in both groups had decreased compared with those on the 2nd day, showing a gradual recovery of maternal moods over time. However, the study group still maintained lower scores in multiple sub-items, such as “difficulty sleeping” and “feeling sad”, indicating a more significant effect in improving sleep disturbances and alleviating depression. See **Tables 2**, **3**.

Comparison of postoperative ObsQoR-10 scores

In the comparison of ObsQoR-10 scores at 24 and 48 hours postoperatively, the study group had significantly higher scores than the control group in the four dimensions of emotional state, comfort, psychological support, and self-care ability (all P<0.05). See **Figure 3**.

Comparison of resting and movement

VAS scores at each time point: The resting and movement VAS scores at 4 h, 12 h and 24 h postoperatively in the study group were significantly lower than those in the control group (all P<0.05). See **Figure 4**.

Comparison of postoperative analgesic pump usage between the two groups

The time to first press of the analgesic pump in the study group was slightly shorter than that in the control group (5.63±0.81 h vs. 5.79±0.72 h, P>0.05). Within 24 hours postoperatively, the number of presses of the analgesic pump in the study group was significantly lower than that in the control group (2.57±0.74 times vs. 4.15±1.22 times), and within 48 hours postoperatively, the number of presses was also lower than that in the control group (3.55±1.24 times vs. 4.75±1.33 times, all P<0.05). This indicates that patients in the study group had lower postoperative analgesic requirements and better pain relief. See **Table 4**.

Comparison of safety assessment

There were no statistically significant differences in the mean arterial pressure and heart rate between the two groups of patients at all

Table 2. Comparison of EPDS score on the second day after delivery

Project	Control group (n=68)	Study group (n=68)	t	P
1. Feeling happy	2.35±0.48	2.13±0.40	2.904	0.004
2. Feeling optimistic about the future	2.16±0.37	1.91±0.29	4.385	<0.001
3. Blaming oneself unnecessarily	2.38±0.50	2.07±0.31	4.345	<0.001
4. Feeling anxious or worried	2.66±0.48	2.44±0.50	2.633	0.009
5. Feeling scared or frightened for no reason	2.13±0.34	2.0±0.30	2.364	0.020
6. Being overly troubled by everything	2.13±0.34	1.89±0.32	4.289	<0.001
7. Having difficulty dealing with things	2.69±0.47	2.47±0.50	2.655	0.009
8. Having difficulty falling asleep	2.43±0.50	2.12±0.32	4.284	<0.001
9. Feeling sad or in pain	2.06±0.30	1.85±0.43	3.250	0.002
10. Having thoughts that hurt oneself	2.35±0.48	2.16±0.48	2.326	0.022
Total scores	23.34±2.01	21.10±2.02	6.482	<0.001

Table 3. EPDS score on the 7th day postpartum

Project	Control group (n=68)	Study group (n=68)	t	P
1. Feeling happy	1.95±0.30	1.66±0.48	4.117	<0.001
2. Feeling optimistic about the future	1.88±0.44	1.39±0.49	6.048	<0.001
3. Blaming oneself unnecessarily	2.07±0.31	1.79±0.48	4.044	<0.001
4. Feeling anxious or worried	2.51±0.53	2.31±0.53	2.270	0.025
5. Feeling scared or frightened for no reason	1.88±0.32	1.57±0.53	4.114	<0.001
6. Being overly troubled by everything	1.82±0.42	1.63±0.49	2.451	0.016
7. Having difficulty dealing with things	2.49±0.53	2.16±0.41	3.973	<0.001
8. Having difficulty falling asleep	2.18±0.38	1.99±0.32	3.142	0.002
9. Feeling sad or in pain	1.82±0.42	1.65±0.54	2.125	0.036
10. Having thoughts that hurt oneself	2.09±0.29	1.76±0.47	4.919	<0.001
Total scores	20.55±2.21	17.86±2.17	7.162	<0.001

observation time points during the intervention (P>0.05). See **Table 5**.

Comparison of postoperative recovery

The study group had more breastfeeding sessions within 48 hours after surgery, with earlier first mobilization, first breastfeeding, and first anal exhaust times than the control group (all P<0.05). See **Figure 5**.

Comparison of adverse events

During intraoperative adverse reactions, the most common adverse events in the study group were dizziness (20.6%), vomiting (17.6%) and nausea (7.4%), while in the control group they were vomiting (17.6%), nausea (10.3%) and dizziness (16.2%). Although the incidence of dizziness was high in both groups, it was slightly higher in the study group. Additionally, a few parturients in both groups experienced mild central nervous system-related reactions such as hallucinations, dissociative reactions, hypertension, increased muscle tone, agitation, and nystagmus, with no statistically significant differences between the groups (all P>0.05). See **Table 6**.

Discussion

This study focused on women undergoing caesarean section and investigated the effects of immediate intravenous infusion of low-dose esketamine (0.2 mg/kg over 40 min) after fetal delivery on postpartum depression symptoms and the quality of postoperative recovery. The results demonstrated that compared to the control group, the study group had significantly lower EPDS scores at multiple postoperative time points - a marked reduction in the incidence of postpartum depression on the third postoperative day, significantly improved ObsQoR-10 scores, and better post-

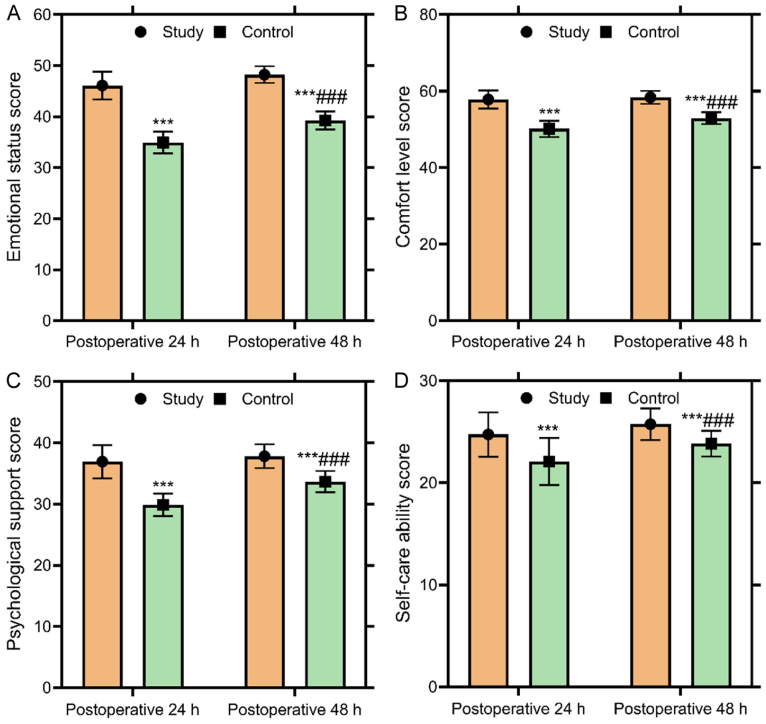

Figure 3. Comparison of postoperative ObsQoR-10 scores between the two groups. A. Emotional state; B. Comfort level; C. Psychological support; D. Self-care ability. Compared with control group, ***P<0.001, compared with 24 h after surgery, ###P<0.001.

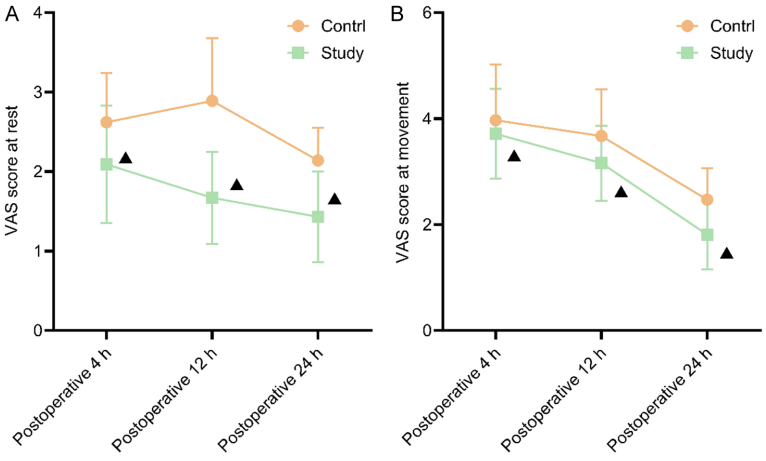

Figure 4. Comparison of VAS scores at rest (A) and during exercise (B) between the two groups of patients at each time point. Compared with control group, ▲P<0.05.

operative functional recovery indicators. This indicates that low-dose esketamine has excellent effects in alleviating postpartum depression and promoting postoperative rehabilitation, with good safety. Intravenous infusion of 0.5 mg/kg ketamine is the most commonly used dose for treating depression, with mood improvement lasting about a week, and increasing the frequency of treatment can extend the antidepressant effect [12]. Unfortunately, the risk of addiction and tolerance to ketamine leads many practitioners to be cautious about repeated injections [13]. Esketamine, as a new anesthetic drug, has recently been shown to have significant antidepressant effects [14, 15]. Additionally, the drug exhibits certain analgesic potential, which may be related to its non-competitive blockade of NMDA receptors, thereby inhibiting receptor activation, reducing neuronal excitability, and producing both anesthetic and analgesic effects [16]. Furthermore, esketamine can also participate in pain relief by activating opioid receptors [17, 18]. Regarding clinical dose selection, research has indicated that in the context of caesarean section, a dose of 1 mg/kg esketamine has been proven to be safe and feasible [19]. In this study, we adopted an innovative administration strategy: low dose esketamine (0.2 mg/kg, 40 min) was administered intravenously immediately after delivery, combined with postoperative PCIA analgesia maintenance. This regimen effectively overcomes the limita tion of the short duration of effect of a single intravenous infusion while also addressing the issue of insufficient blood drug concentration that may occur with standalone PCIA. In addition, this administration method can significantly reduce the occurrence of common postoperative adverse reactions. Thus this study offers a promising intervention strategy that may optimize the risk-benefit ratio in the management of postpartum depression syndrome.

Table 4. Comparison of usage of postoperative analgesic pumps

Groups	The first compression time of the analgesic pump (h)	The number of compressions of the analgesic pump within 24 hours after the operation (times)	The number of compressions of the analgesic pump within 48 hours after the operation (times)
Control group (n=68)	5.79±0.72	4.15±1.22	4.75±1.33
Study group (n=68)	5.63±0.81	2.57±0.74	3.55±1.24
t	1.217	9.131	5.442
P	0.226	<0.001	<0.001

Table 5. Comparison of safety assessment

Groups	HR				MAP			
	2 h	4 h	24 h	48 h	2 h	4 h	24 h	48 h
Control group (n=68)	83.60±15.20	74.75±13.90	78.10±14.80	82.10±11.85	85.10±12.20	80.30±10.95	86.90±12.10	90.30±8.90
Study group (n=68)	83.25±12.45	74.30±12.10	78.85±13.10	81.90±12.00	85.00±12.00	80.00±11.00	87.20±12.30	91.55±9.25
t	0.147	0.201	0.313	0.098	0.048	0.159	0.143	0.803
P	0.883	0.847	0.755	0.922	0.962	0.874	0.886	0.423

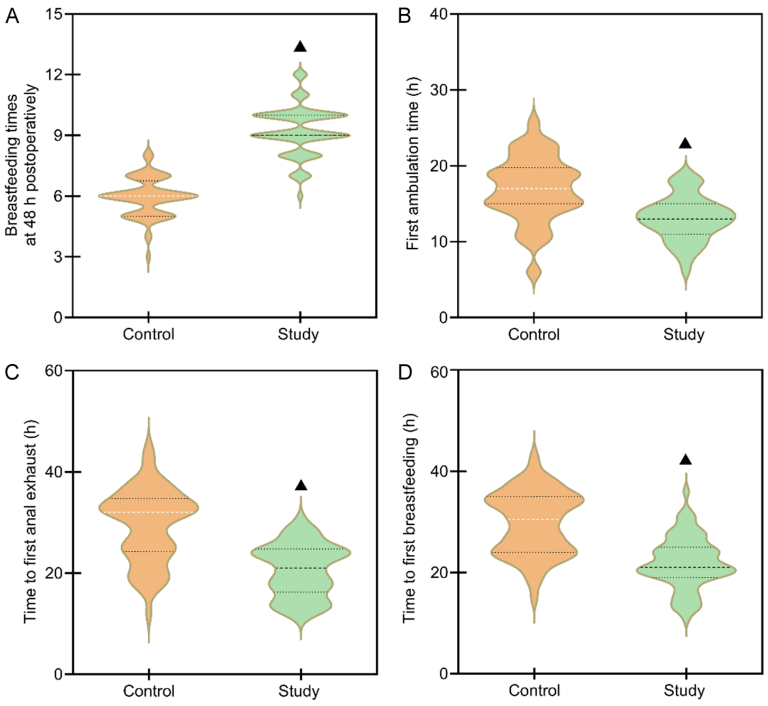

Figure 5. Postoperative recovery indicators. A. Number of breastfeeding sessions within 48 hours post-surgery; B. Time to first mobilization; C. Time to first anal exhaust; D. Time to first breastfeeding. Compared with the control group, ▲P<0.05.

Esketamine is the right-handed enantiomer of ketamine, and its mechanism of action mainly involves non-competitive antagonism of NMDA receptors, blocking the neurotoxicity of glutamate, enhancing AMPA receptor activity, activating the mTOR signaling pathway, and increasing presynaptic release of BDNF, thereby improving synaptic plasticity, regulatingfunctional connectivity in emotion-related brain regions, and exerting rapid antidepressant effects [20, 21]. Studies have confirmed that a single low dose of esketamine can take effect within 24 hours, continuously alleviating depressive symptoms, with some studies indicating effects lasting up to 7 days or even more than 2 weeks, and with mild adverse reactions and good patient compliance [22]. The results of this study are consistent with the aforementioned literature, with the study group showing a significant decrease in EPDS scores on the third day postoperatively, suggesting rapid antidepressant effects of esketamine. On the 14th and 28th postoperative days, the study group maintained lower EPDS scores, indicating some persistence of the antidepressant effect. In addition, ObsQoR-10 scores in the study group were significantly higher than those of the control group, especially in terms of emotional state, comfort, emotional support, and independence, indicating that esketamine may not only indirectly promote postoperative recovery through mood improvement but also directly enhance the postoperative experience by affecting central pain modu-

Table 6. Comparison of intraoperative and postoperative adverse events

Adverse events	Study group (n=68)	Control group (n=68)	*P
Disgusting	5 (7.35%)	7 (10.29%)	0.545
Vomiting	12 (17.65%)	12 (17.65%)	1.000
Dizziness	14 (20.59%)	11 (16.18%)	0.507
Illusion	1 (1.47%)	2 (2.94%)	1.000
Dissociation	1 (1.47%)	3 (4.41%)	0.619
hypertension	1 (1.47%)	0 (0.0%)	1.000
Tremble	1 (1.47%)	0 (0.0%)	1.000
Hypertonia	1 (1.47%)	1 (1.47%)	1.000
Restless and agitated	1 (1.47%)	1 (1.47%)	1.000
Nystagmus	2 (2.94%)	1 (1.47%)	1.000
Postoperative nausea	1 (1.47%)	0 (0.0%)	1.000
Postoperative vomiting	6 (8.82%)	9 (13.24%)	0.412
Postoperative dizziness	3 (4.41%)	4 (5.88%)	1.000
Postoperative hypertension	0 (0.0%)	0 (0.0%)	1.000
Postoperative cold sweat	1 (1.47%)	0 (0.0%)	1.000

*Fisher's exact test.

lation and alleviating postoperative discomfort.

The study group showed significantly earlier times for first ambulation, first anal exhaust, and first breastfeeding compared to the control group, and the number of breastfeedings within 48 hours post-surgery was also significantly increased, suggesting that the intervention can accelerate the functional recovery of postpartum women. This may be due to improved patient cooperation with recovery behaviors following better emotional status, or the multidimensional alleviating effects of esketamine on postoperative fatigue, pain, and anxiety. Notably, although esketamine has psychoactive properties, it did not induce common psychiatric side effects such as agitation, hallucinations, or dissociation in this study; patients remained awake and cooperative, demonstrating good safety. Regarding the newborns, there was no statistically significant difference in neonatal intensive care unit admission rates between groups, further supporting that esketamine has minimal impact on neonatal safety, consistent with its pharmacological characteristics of weak placental transfer and rapid metabolism.

Despite the positive conclusions of this study, certain limitations still remain. Firstly, the study was conducted at a single clinical center, and the sample size was relatively small due to restrictions on sample availability and follow-up management, which may affect external generalizability. Secondly, only the effects of a single postoperative medication were observed, and multiple or staged dosing strategies were not evaluated. Thirdly, monitoring of relevant biomarkers (such as BDNF, IL-6, CRP, etc.) was lacking, so mechanistic inferences still require experimental data support. Future research is recommended to expand the sample size, adopt a multicenter design, and combine neuropsychological assessments, biochemical tests, and brain imaging techniques to systematically evaluate the application value and mechanisms of esketamine in perinatal mood disorder interventions, providing theoretical support for more precise and individualized clinical intervention programs.

In summary, immediate intravenous infusion of low-dose esketamine after fetal delivery, and it being combined with postoperative PCIA for pain management maintenance, can effectively alleviate postpartum depression symptoms, improve recovery quality, promote functional restoration following caesarean section, and it is safe. It has a broad application prospect in perioperative rapid recovery and mood interventions.

Acknowledgements

This work was supported by the Clinical Research Fund Protection Special Project of Guangdong Medical Association (2024HYA4009).

Disclosure of conflict of interest

None.

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