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Effect of intravenous esketamine on postoperative sleep disturbance, anxiety, and depression in elderly patients undergoing laparoscopic abdominal surgery: a randomized controlled trial

Haijin Wang[1†], Lan Wang[1†], Jing Gao[1*] and Fengqi Zhou[1*]

Abstract

Background The population of elderly individuals undergoing surgical procedures is increasing, necessitating effective postoperative management strategies. Postoperative sleep disturbance, anxiety, and depression are significant contributors to overall recovery in this demographic, especially following laparoscopic abdominal surgery.

Methods This study included 200 records of elderly patients undergoing laparoscopic abdominal surgery. Patients were divided into an esketamine group, receiving intravenous esketamine, and a control group, receiving normal saline. Parameters such as surgery and anesthesia duration, fluid volume, blood loss, urine output, sleep disturbance, anxiety, depression, pain assessment, and adverse events were compared between the two groups.

Results The esketamine group had significantly fewer postoperative sleep disturbances, lower anxiety and depression scores on days 1 and 3, and lower Visual Analog Scale (VAS) scores compared to the control group ($P < 0.05$). They also required less rescue analgesia, used fewer opioids, and consumed fewer non-opioid analgesics ($P < 0.05$). However, the esketamine group experienced a higher incidence of dissociative symptoms ($P < 0.05$), while other adverse events were similar between the groups. Overall, esketamine improved pain management and reduced anxiety and depression but increased the risk of dissociative symptoms.

Conclusions Intravenous esketamine administration in elderly patients undergoing laparoscopic abdominal surgery was associated with reduced postoperative sleep disturbance, lower postoperative pain scores, lower anxiety and depression scores, decreased rescue analgesia requirements, reduced opioid consumption, and a lower use of non-opioid analgesic medications.

†Haijin Wang and Lan Wang contributed equally to this work.

*Correspondence:
Jing Gao
gao912626@163.com
Fengqi Zhou
smile.chow@163.com

Full list of author information is available at the end of the article

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Keywords Intravenous esketamine, Elderly patients, Laparoscopic abdominal surgery, Postoperative sleep disturbance, Pain management

Introduction

The population of elderly individuals undergoing surgical procedures has been steadily increasing due to advancements in medical care, leading to a growing need for effective postoperative management strategies tailored to this demographic [1, 2]. Among the array of challenges faced by elderly surgical patients, postoperative sleep disturbance, anxiety, and depression emerge as significant contributors to overall recovery and well-being [3]. Laparoscopic abdominal surgery, a commonly performed procedure in the elderly population, presents specific concerns related to postoperative complications, including sleep disturbances and psychological distress [4]. In light of these considerations, the exploration of pharmacological interventions targeting these outcomes is of paramount importance in optimizing postoperative care for elderly surgical patients [5].

Esketamine, a non-competitive N-methyl-D-aspartate (NMDA) receptor antagonist, has shown promising results in managing depression and acute pain is based on the known pharmacological properties of esketamine [6, 7]. Esketamine is a glutamatergic modulator that has been studied for its potential in the treatment of depression, particularly treatment-resistant depression [8]. It acts as a non-competitive antagonist of the NMDA receptor, which is involved in the regulation of synaptic plasticity and has been implicated in the pathophysiology of mood disorders [9, 10]. Additionally, esketamine has demonstrated rapid-acting antidepressant effects in clinical trials, leading to its approval for use in treatment-resistant depression. Furthermore, esketamine has also been studied for its analgesic properties in managing acute pain. Its mechanism of action involves modulation of the central sensitization process, which is relevant to the perception of pain. Postoperative sleep disturbance represents a prevalent and burdensome aspect of recovery following surgical procedures, with implications for overall well-being and functional outcomes [11]. Sleep disturbances, including disrupted sleep patterns, insomnia, and altered sleep architecture, are frequently reported in the postoperative period, posing challenges to recuperation and physical recovery in elderly patients [12]. The significance of addressing postoperative sleep disturbance is underscored by its potential to influence pain perception, cognitive function, and psychological recovery, highlighting the need for effective interventions to mitigate its impact on elderly surgical patients [13, 14]. Anxiety and depression represent additional dimensions of concern in the postoperative care of elderly surgical patients, with implications for recovery, functional outcomes, and overall quality of life [15, 16]. The psychological distress experienced in the postoperative period can manifest as anxiety, despondency, and reduced psychological well-being, warranting comprehensive strategies to address these aspects of patient care [17]. The multifaceted implications of anxiety and depression on postoperative recovery emphasize the need for targeted interventions that encompass both pharmacological and non-pharmacological modalities to support the psychological well-being of elderly surgical patients [18, 19].

In the context of laparoscopic abdominal surgery, which encompasses a spectrum of procedures ranging from cholecystectomy to colectomy, the specific challenges related to postoperative sleep disturbance, anxiety, and depression in elderly patients necessitate tailored interventions that incorporate the nuanced considerations of this patient population. The potential of intravenous esketamine to address these multifaceted challenges represents an area of interest that warrants comprehensive investigation, encompassing the impact of esketamine on postoperative sleep quality, pain control, and psychological recovery in elderly surgical patients [20]. This study aimed to investigate the effect of intravenous esketamine on postoperative sleep disturbance, anxiety, and depression in elderly patients undergoing laparoscopic abdominal surgery. By elucidating the potential impact of intravenous esketamine on the multifaceted dimensions of postoperative recovery in this patient population, this research contributes to the ongoing efforts to optimize postoperative care for elderly surgical patients. Furthermore, the exploration of the multifaceted effects of esketamine in the context of postoperative care in elderly patients undergoing laparoscopic abdominal surgery holds significant implications for enhancing the quality and comprehensiveness of postoperative management strategies tailored to this demographic.

Methods

Study design and population

A randomized controlled trial (RCT) was conducted on 200 elderly patients who underwent laparoscopic abdominal surgery at Xiangyang No.1 People's Hospital. Patients were allocated into control group ($n = 100$) and esketamine group ($n = 100$) by using computer-generated randomization. The randomization sequence was generated by an independent statistician using a random number table, and the allocation was concealed using sealed, opaque envelopes. Group assignments were revealed to

the anesthesiologist administering the treatment immediately prior to induction of anesthesia. Both patients and outcome assessors were blinded to group allocation. Inclusion criteria were as follows: patients undergoing laparoscopic abdominal surgery aged 60 years or older, with normal coagulation, liver, and kidney function, and complete clinical records. Exclusion criteria included severe cognitive impairment, contraindications to the anesthetic drugs used in this study, intraoperative conversion to open surgery, and long-term use of psychotropic drugs (Fig. 1). The sample size was calculated based on published data from Qiu et al. [21], which reported the incidence of postoperative sleep disturbance on postoperative day 1 as 22.8% in the esketamine group and 44.0% in the control group. Using a two-sided test with a significance level of 0.05 and a power of 80%, the minimum required sample size was calculated to be 78 patients per group. Allowing for a 10% dropout rate, the final sample size was adjusted to 87 patients per group, resulting in a total of 174 participants. Our study included 200 participants (100 in each group), which exceeded the required sample size. This ensured that our study was adequately powered to detect differences in postoperative sleep disturbance and other outcomes.

This study was approved by the medical ethics committee of Xiangyang No.1 People's Hospital. Informed consent forms were obtained from each participant and his/her guardian. The procedures were conducted in accordance with the ethical standards set forth by the Committee on Human Experimentation and the Helsinki Declaration of 1975, as revised in 2000. This clinical study was registered at Chinese Clinical Trial Registry (ChiCTR, ChiCTR2400087795).

Treatment method

Patients in the esketamine group received intravenous esketamine at a dose of 0.3 mg/kg/h (Jiangsu Hengrui Medicine Co., Ltd., China), starting 10 min before the induction of anesthesia and continuing until the end of the surgical procedure. The total dose of esketamine administered was calculated based on the duration of surgery for each patient. Meanwhile, patients in the control group were administered an equivalent volume of normal saline. Both esketamine and normal saline were prepared by the same nurse, who was not involved in the study, using a 20 mL syringe to dilute 50 mg of esketamine to 20 mL with normal saline. Personnel involved in patient management and postoperative follow-up anesthesia care were randomly assigned to the two groups, and the allocation was not disclosed to the patients before discharge.

Data collection

According to the American Society of Anesthesiologists (ASA) physical status classification system, the ASA score was used to assess the patient's physical condition and surgical risk prior to anesthesia consisting six grades. The specific grading criteria are as follows: Grade 1 refers to a healthy patient capable of withstanding anesthesia; Grade 2 indicates a patient with mild systemic disease, no functional limitations, and able to withstand anesthesia; Grade 3 represents a patient with severe systemic

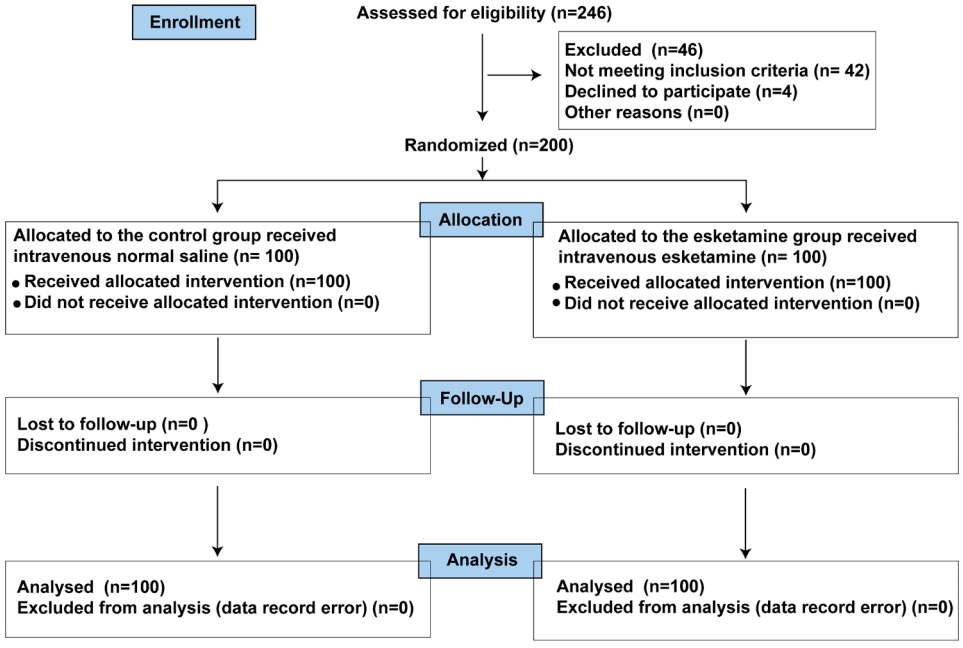

Fig. 1 Flowchart of study design

disease and some functional impairment, but still able to tolerate anesthesia; Grade 4 denotes a patient with severe systemic disease requiring lifelong continuous treatment, posing a high anesthetic risk, and necessitating thorough preoperative anesthesia preparation; Grade 5 indicates a moribund patient who is unlikely to survive for 24 h, regardless of surgery; Grade 6 refers to a brain-dead patient. In addition, the VAS score was a commonly used pain assessment tool, used to evaluate pain intensity, including chronic and postoperative pain in clinical practice.

In addition, Postoperative sleep quality was evaluated using the numeric rating scale (NRS), postoperative sleep disturbance was defined as having an NRS score of 6 or higher, indicating that sleep was repeatedly interrupted throughout the night, or even worse [22]. The NRS score ranges from 0 to 10, wherein 0 represents excellent or good sleep and 10 represents the inability to fall asleep all night [23].

The VAS score was typically represented by a horizontal line or vertical column, with "no pain" and "worst possible pain" at each end, and patients mark a point between these two ends to indicate their current level of pain. The VAS score ranged from 0 to 10, with the following standard interpretations: 0: no pain; 1–3: mild pain, which is tolerable; 4–6: moderate pain, significantly affecting daily activities and comfort; 7–9: severe pain, requiring immediate intervention and management; 10: worst possible pain, unbearable and needing urgent treatment for pain relief.

The Hospital Anxiety and Depression Scale (HADS) is a tool used to assess symptoms of anxiety and depression. It comprises two subscales: the Anxiety subscale (HADS-A) and the Depression subscale (HADS-D). For each item, respondents select the degree of severity, ranging from 0 to 3, representing none, mild, moderate, and severe. The total score for each subscale ranges from 0 to 21, with higher scores indicating more severe anxiety or depression symptoms. Scores of 0–7 are considered normal, 8–10 suggest the possibility of mild anxiety or depression, 11–14 indicate the possibility of moderate anxiety or depression, and 15–21 signify the possibility of severe anxiety or depression. It is important to note that the HADS is used as a preliminary screening tool and is not intended for diagnostic purposes. Any indications of potential anxiety or depression symptoms from the initial screening should be followed up with a professional clinical assessment and diagnostic confirmation.

The collection of patient data included general information (age, gender, smoking history, alcohol history, ASA score, and type of abdominal surgery); intraoperative parameters (surgery duration, anesthesia duration, blood loss, urine output); HADS to assess anxiety and depression scores, which were collected during the preoperative evaluation phase (one day prior to surgery), as well as on postoperative day 1 and postoperative day 3; postoperative sleep disturbance (sleep disturbance on postoperative day 1, sleep disturbance on postoperative day 3); postoperative pain assessment (VAS score at 24 h postoperatively, VAS score at 48 h postoperatively, rescue analgesia rate); postoperative analgesic medication use (opioid consumption, non-opioid analgesic use); and the incidence of adverse events (nausea/vomiting, headache, dizziness, dissociative symptoms, sedation).

Statistical analysis

The data were analyzed using SPSS 25.0 statistical software (SPSS Inc., Chicago, IL, USA). Categorical data were represented as [n, (%)], and the chi-square test was applied to compare group differences. The theoretical frequency (T) for each cell in a contingency table was calculated based on the expected counts under the null hypothesis using the formula: T = (Row Total × Column Total) / Grand Total. When the sample size was ≥ 40 and $T \geq 5$, the chi-square test was performed using the basic formula: $\chi^2 = \Sigma(O_i - E_i)^2 / E_i$, where O_i and E_i are the observed and expected values, respectively. When the sample size was ≥ 40 but $1 \leq T < 5$, the chi-square test was adjusted using the continuity correction (Yates' correction) formula: $\chi^2 = \Sigma(|O_i - E_i| - 0.5)^2 / E_i$. For smaller sample sizes (< 40) or when $T < 1$), Fisher's exact test was used to ensure accurate statistical inference. Continuous variables were expressed as mean ± standard deviation (SD) and were analyzed using the independent samples t-test for normally distributed data, while non-normally distributed data were analyzed using the Wilcoxon rank-sum test. To account for the mixed design of the study, which included a between-subject factor (treatment group: esketamine vs. saline) and a within-subject factor (time: preoperative, postoperative day 1, and postoperative day 3), a repeated-measures ANOVA was applied for normally distributed data to analyze interaction effects between the treatment group and time, as well as the main effects of each factor. For non-normally distributed data, generalized linear mixed models (GLMM) were used to assess changes across time points while accounting for variability within and between subjects. Post-hoc pairwise comparisons were conducted with Bonferroni corrections to control for multiple testing. A significance level of $P < 0.05$ was considered statistically significant.

Results

Baseline characteristics

Baseline characteristics of the study participants, including age, gender distribution, body mass index (BMI), smoking history, alcohol intake, ASA score, HADS score, and surgical procedures, were comparable between the two groups, as evidenced by non-significant differences

Table 1 Baseline characteristics of study participants

Variable	Control Group ($n=100$)	Esketamine Group ($n=100$)	t/χ^2	*P* value
Age (years)	72.65 ± 5.33	73.02 ± 5.61	0.476	0.635
Males/females (n)	56 / 44	67 / 33	2.112	0.146
BMI (kg/m^{-2})	25.14 ± 3.25	25.53 ± 3.42	0.829	0.408
Smoking history (pack-years)	28.52 ± 7.24	26.94 ± 6.55	1.619	0.107
Alcohol intake (g/week)	20.15 ± 4.53	19.33 ± 3.85	1.373	0.171
ASA score (I/II/III, %)	45/40/15	42/45/13	0.54	0.763
HADS-A score	8.5 ± 2.1	8.3 ± 2.3	0.642	0.522
HADS-D score	8.2 ± 2.4	8.1 ± 2.5	0.289	0.773
Surgical Procedures				
Laparoscopic Cholecystectomy [(n, %)]	30 (30%)	35 (35%)	0.681	0.878
Laparoscopic Appendectomy [(n, %)]	20 (20%)	18 (18%)		
Laparoscopic Hysterectomy [(n, %)]	25 (25%)	22 (22%)		
Laparoscopic Colectomy [(n, %)]	25 (25%)	25 (25%)		

Table 2 Comparison of intraoperative parameters between the control group and esketamine group

Parameter	Control Group ($n=100$)	Esketamine Group ($n=100$)	t	*P* value
Surgery duration (minutes)	130.23 ± 20.58	125.34 ± 18.56	1.761	0.08
Anesthesia duration (minutes)	182.43 ± 31.56	175.36 ± 28.67	1.660	0.099
Intraoperative fluid volume (mL)	1203.14 ± 206.33	1153.47 ± 180.39	1.812	0.071
Blood loss (mL)	50.11 ± 15.34	47.58 ± 10.56	1.361	0.175
Urine output (mL/h)	109.65 ± 23.89	113.96 ± 25.47	1.235	0.218

in all parameters ($P>0.05$) (Table 1). Therefore, the baseline characteristics of the study cohorts were similar, suggesting that the observed differences in postoperative sleep disturbance, anxiety, and depression could be attributed to the use of intravenous esketamine.

Intraoperative parameters

Analysis revealed no statistically significant differences in surgery duration, anesthesia duration, intraoperative fluid volume, blood loss and urine output between the two groups ($P>0.05$) (Table 2). These results indicated that the administration of intravenous Esketamine did not significantly impact the intraoperative parameters in elderly patients undergoing laparoscopic abdominal surgery.

Effectiveness analysis

In a comparison of postoperative sleep disturbance between the control group and the esketamine group, the study revealed that on postoperative day 1, the percentage of patients experiencing sleep disturbance in the esketamine group was significantly lower than in the control group ($P<0.05$). Similarly, on postoperative day 3, the percentage of patients experiencing sleep disturbance in the esketamine group was significantly lower than in the blank control group ($P<0.05$) (Table 3). These findings suggested that intravenous esketamine administration may have a beneficial effect in reducing postoperative sleep disturbance in elderly patients undergoing laparoscopic abdominal surgery.

Table 3 Comparison of postoperative sleep disturbance

Parameter	Control Group ($n=100$)	Esketamine Group ($n=100$)	χ^2	*P* value
Postoperative Day 1 Sleep Disturbance (%)	45 (45.0%)	30 (30.0%)	3.000	0.041
Postoperative Day 3 Sleep Disturbance (%)	35 (35.0%)	20 (20.0%)	4.091	0.027

On the one hand, it was observed that on postoperative day 1 and day 3, the mean HADS-A score in the esketamine group was significantly lower than in the blank control group ($P<0.05$) (Fig. 2A), indicating a reduction in anxiety levels. On the other hand, HADS-D score, on postoperative day 1, the mean score in the esketamine group was significantly lower than in the blank control group, and on postoperative day 3, the mean score in the esketamine group was significantly lower than in the blank control group ($P<0.05$) (Fig. 2B). It suggested that intravenous esketamine administration is associated with reduced anxiety and depression in elderly patients undergoing laparoscopic abdominal surgery.

The esketamine group exhibited significantly lower postoperative 24-hour VAS scores compared to the control group ($P<0.001$). Similarly, at 48 h postoperatively, the esketamine group demonstrated significantly lower VAS score compared to the control group ($P<0.01$) (Fig. 2C). Moreover, the esketamine group exhibited significantly lower postoperative opioid consumption compared to the control group ($P<0.001$) (Fig. 2D). The use of analgesic medication could also reflect effect of intravenous esketamine, the rescue analgesia rate was significantly lower in the esketamine group compared to the control group ($P<0.05$) (Fig. 2E). In addition, a lower percentage of patients in the esketamine group used non-opioid analgesics postoperatively compared to the control group ($P<0.05$) (Fig. 2F). The results indicated that the administration of intravenous esketamine was associated with reduced postoperative pain and a lower requirement for rescue analgesia in elderly patients undergoing laparoscopic abdominal surgery. Furthermore, the administration of intravenous esketamine was associated with reduced postoperative opioid consumption and a

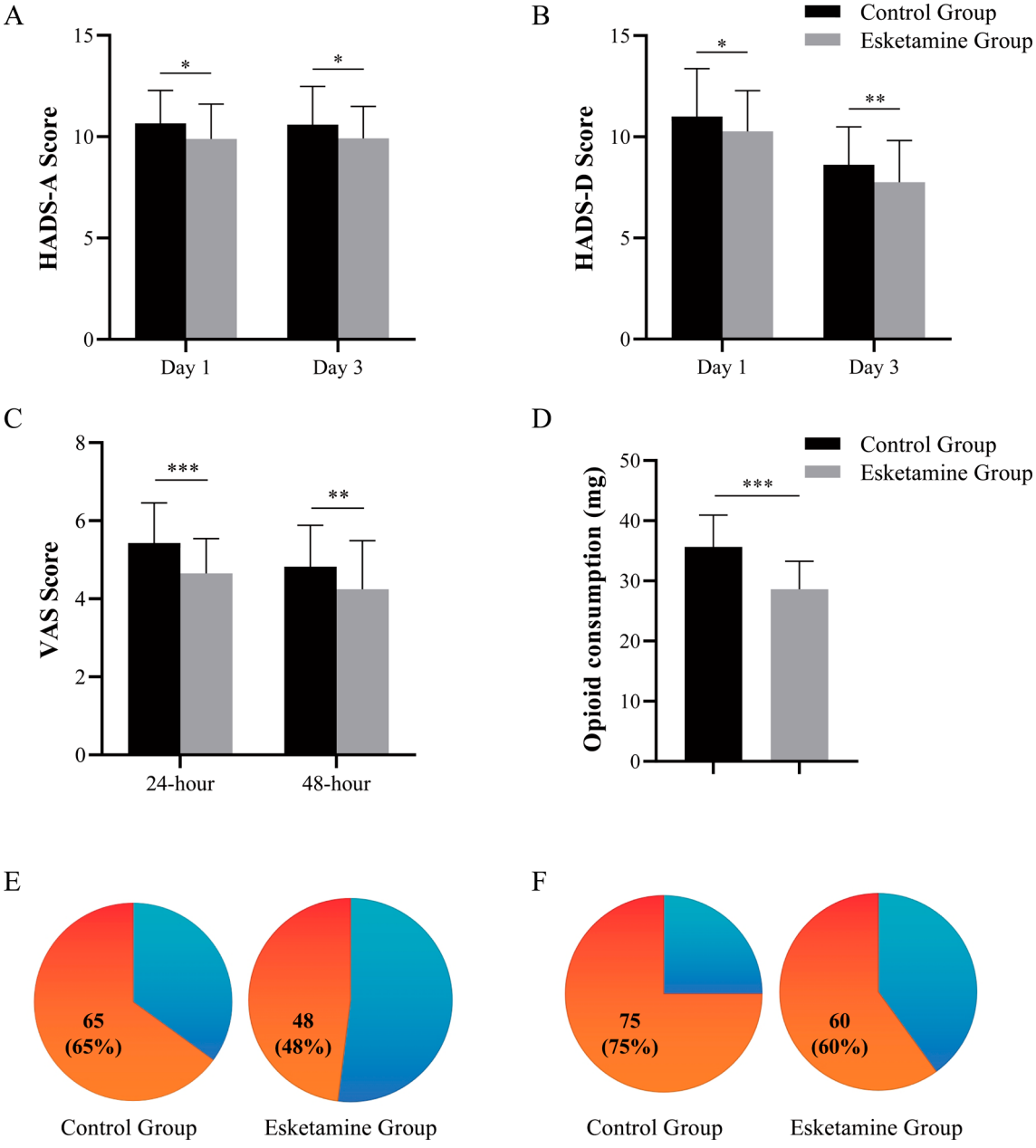

Fig. 2 Difference in negative emotion outcomes, pain intensity and frequency between the control group and esketamine group. (**A**) Comparison of anxiety score between two groups in postoperative day 1 and day 3, *$P<0.05$. (**B**) Comparison of depression score between two groups in postoperative day 1 and day 3, *$P<0.05$, **$P<0.01$. (**C**) Comparison of Postoperative 24-hour and 48-hour VAS score between two groups, **$P<0.01$, ***$P<0.001$. (**D**) Comparison of postoperative opioid consumption used between two groups, ***$P<0.001$. (**E**) Rescue analgesia rate in two groups, orange area was the number of patients who required postoperative rescue analgesia. (**F**) Postoperative non-opioid analgesic using rate in two groups, orange area was the number of patients who used non-opioid analgesic

lower use of non-opioid analgesic medications in elderly patients undergoing laparoscopic abdominal surgery.

Adverse events and side effects

The esketamine group demonstrated a significantly higher incidence of dissociative symptoms compared to the control group ($P<0.01$). However, there were no statistically significant differences in the incidence of nausea or vomiting, headache, dizziness or lightheadedness and sedation between the two groups ($P>0.05$) (Table 4). These findings suggest that the use of intravenous esketamine was associated with a higher incidence of dissociative symptoms, while the incidence of other adverse events and side effects was comparable between the study groups.

Table 4 Adverse events and side effects in two groups

Parameter	Control Group ($n=100$)	Esketamine Group ($n=100$)	χ^2	*P* value
Nausea or Vomiting [n, (%)]	15 (15.0%)	10 (10.0%)	0.731	0.392
Headache [n, (%)]	10 (10.0%)	12 (12.0%)	0.051	0.821
Dizziness or Lightheadedness [n, (%)]	9 (9.0%)	6 (6.0%)	0.288	0.591
Dissociative Symptoms [n, (%)]	3 (3.0%)	15 (15.0%)	7.387	0.007
Sedation [n, (%)]	7 (7.0%)	5 (5.0%)	0.089	0.766

Discussion

Laparoscopic abdominal surgery is common in elderly patients, presenting specific challenges related to postoperative complications [24]. The use of intravenous esketamine has been a subject of interest in managing postoperative symptoms, with potential effects on pain control and psychological well-being [25]. This study aimed to investigate the impact of intravenous esketamine on postoperative sleep disturbance, anxiety, depression, and pain in elderly patients undergoing laparoscopic abdominal surgery. The findings from this study contribute to the understanding of the potential benefits and drawbacks of employing intravenous esketamine in this patient population. Esketamine, a dissociative anesthetic, exerts its effects through modulation of various neurotransmitter systems, particularly the glutamatergic system, which plays a crucial role in pain perception, mood regulation, and sleep-wake cycles [26, 27]. Esketamine's primary mechanism of action involves antagonism of N-methyl-D-aspartate (NMDA) receptors in the central nervous system [28]. By blocking NMDA receptors, esketamine inhibits the transmission of pain signals and modulates synaptic plasticity, potentially leading to reduced pain perception in the postoperative period [29]. Furthermore, the modulation of NMDA receptors has been associated with alterations in sleep architecture, potentially contributing to improved sleep quality and reduced postoperative sleep disturbance [7, 30]. The results indicated a significant reduction in postoperative sleep disturbance in the Esketamine Group compared to the Blank Control Group. This finding is consistent with previous research demonstrating esketamine's potential to improve sleep quality and reduce the incidence of postoperative sleep disturbances. The mechanism underlying esketamine's effect on sleep remains an area of interest, with studies suggesting its role in regulating sleep cycles and mitigating postoperative insomnia. Further investigation into the specific mechanisms through which esketamine influences sleep patterns is warranted, as it could provide valuable insights for improving postoperative care in elderly patients.

Anxiety and depression are prevalent concerns following surgical procedures, particularly in elderly patient populations [31]. While the study primarily focused on postoperative sleep disturbance and pain, it is important to address the potential impact of esketamine on anxiety and depression [25]. Esketamine's influence on neurotransmitter systems, including glutamate, gamma-aminobutyric acid (GABA), and monoamines such as serotonin and dopamine, may underlie its potential to impact psychological well-being [32, 33]. By modifying the balance of these neurotransmitters, esketamine could exert anxiolytic and antidepressant effects, potentially alleviating anxiety and depression in the postoperative period [34, 35]. Some studies have suggested that esketamine may have antidepressant and anxiolytic effects, which could be relevant in the postoperative period. The findings of this study revealed that intravenous esketamine administration was associated with reduced levels of anxiety and depression on both postoperative days 1 and 3. The observed decrease in anxiety and depression scores in the esketamine group compared to the blank control group underscores the potential of esketamine to address psychological distress in the postoperative period. These findings are consistent with the multifaceted pharmacological properties of esketamine, including its impact on mood regulation and psychological well-being. The reduction in anxiety and depression scores following esketamine administration is particularly noteworthy given the implications of psychological well-being on postoperative recovery, functional outcomes, and overall quality of life [36, 37]. By modulating neurotransmitter systems involved in mood regulation, esketamine presents a promising avenue for addressing the psychological dimensions of recovery in elderly surgical patients, highlighting the significance of comprehensive strategies that encompass both pharmacological and non-pharmacological modalities to support patient well-being.

Esketamine has been shown to possess anti-inflammatory and neuroprotective properties, which may have implications for postoperative recovery [38, 39]. Inflammatory processes and neuroinflammation are increasingly recognized as contributors to pain sensitization, mood disturbances, and sleep disturbances [40]. Esketamine's anti-inflammatory effects may mitigate these processes, potentially leading to improved pain management and psychological well-being postoperatively [41, 42]. The results indicated a significant reduction in postoperative pain, as evidenced by lower VAS scores and decreased rescue analgesia rates in the esketamine Group. The findings align with existing literature supporting esketamine's role in pain management, possibly through its action on N-methyl-D-aspartate (NMDA) receptors [43]. The potential for esketamine to contribute

to multimodal analgesia strategies warrants further exploration, particularly in the context of reducing opioid consumption and minimizing opioid-related adverse effects in elderly surgical patients.

While the study demonstrated beneficial effects of intravenous esketamine on postoperative outcomes, the increased incidence of dissociative symptoms warrants attention. It is important to carefully weigh the potential benefits of esketamine against its adverse effects, particularly in elderly patients who may be more susceptible to certain side effects. Future research should aim to optimize dosing regimens and administration protocols to minimize the occurrence of dissociative symptoms while maintaining the therapeutic benefits of esketamine in this patient population. The findings of this study have important clinical implications for the management of postoperative care in elderly patients undergoing laparoscopic abdominal surgery. The potential role of intravenous esketamine in improving postoperative sleep, reducing pain, and possibly addressing psychological distress underscores its significance as a therapeutic option. However, further research is needed to establish optimal dosing, timing, and long-term outcomes associated with esketamine administration in elderly surgical patients. Long-term follow-up studies assessing the sustained effects of esketamine beyond the immediate postoperative period would provide valuable insights into its overall impact on patient recovery and well-being. It is important to acknowledge several limitations of the study. The sample size and duration of follow-up may have influenced the comprehensive assessment of postoperative outcomes. Additionally, the study focused on specific parameters and did not encompass a broader evaluation of psychological well-being. Future studies should address these limitations and consider a more holistic approach to evaluating the impact of intravenous esketamine on postoperative recovery in elderly surgical patients.

Conclusion

In conclusion, the findings of this study underscore the potential of intravenous esketamine to mitigate postoperative sleep disturbance, reduce pain, and impact psychological well-being in elderly patients undergoing laparoscopic abdominal surgery. While the study yields promising results, further research is warranted to elucidate the optimal use of esketamine in this patient population and address potential concerns regarding adverse effects. By enhancing our understanding of the multifaceted effects of intravenous esketamine, this study contributes to the ongoing efforts to optimize postoperative care for elderly surgical patients.

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Author contributions
Conceptualization, Haijin Wang and Lan Wang; Data curation, Haijin Wang, Lan Wang, Jing Gao and Fengqi Zhou; Investigation, Jing Gao and Fengqi Zhou; Writing– original draft, Haijin Wang, Lan Wang, Jing Gao and Fengqi Zhou; Writing– review & editing, Haijin Wang and Lan Wang. All authors read and approved the final version of the manuscript.

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Data availability
All data generated or analyzed in this study are included in the present manuscript.

Declarations

Ethics approval
This study was approved by the Ethics Committee of Xiangyang No.1 People's Hospital, Hubei University of Medicine in accordance with regulatory and ethical guidelines. Prior to enrollment, all eligible study subjects provided written informed consent. The procedures were conducted in accordance with the ethical standards set forth by the Committee on Human Experimentation and the Helsinki Declaration of 1975, as revised in 2000.

Consent to participate
Informed consent forms were obtained from each participant and his/her guardian.

Competing interests
The authors declare no competing interests.

Author details
[1]Department of Anesthesiology, Xiangyang No.1 People's Hospital, Hubei University of Medicine, No. 15 Jiefang Road, Fancheng District, Xiangyang City, Hubei Province 441000, P.R. China

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