Comparative Study of Retrobulbar Block versus Ketamine Infusion during Eye Enucleation/Evisceration (Randomized Controlled Trial)

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Abstract

Background: The aim of this study is to compare the safety and efficacy of retrobulbar block versus intraoperative ketamine infusion in eye enucleation or evisceration under general anesthesia. Materials and Methods: Forty-five patients belonging to American Society of Anesthesiologists Physical Status I and II undergoing eye enucleation or evisceration were randomly allocated to three equal groups (15 patients each). General anesthesia was used as the standardized technique in all patients. Group R received a single retrobulbar injection, Group K received intravenous ketamine infusion, and Group C received normal saline with the same rate of ketamine infusion. Intraoperative heart rate and mean arterial pressure, recovery time, postoperative pain score, time to first rescue analgesic, number of patients who required rescue analgesia, and any adverse events were reported. Results: Postoperative pain Visual Analog Scale was significantly lower in R and K groups in comparison to the C group and was significantly higher in K than R group at 3, 6, 12, and 24 h. In addition, the time to first rescue analgesic was significantly longer in R group (429 ± 54 min) than that in K group (272 ± 34 min), but compared to both groups, it was longer in C group (52 ± 7 min). In K group, the recovery time was longer with higher sedation score in comparison to the other two groups. Conclusions: Single retrobulbar injection and low-dose ketamine infusion are safe and effective when used as adjuvants to general anesthesia, but retrobulbar block provides better control of postoperative pain with prolonged time to first rescue analgesic and reduced analgesic consumption.

Keywords: Evisceration, eye enucleation, ketamine, postoperative pain, rescue analgesia, retrobulbar block

INTRODUCTION

Enucleation is defined as the removal of the entire eyeball and considered the main treatment for end-stage ocular diseases, such as malignancies and traumatic eye damage,[1] whereas in evisceration, the extraocular muscle and sclera are left intact with the removal of the intraocular content through scleral incision for cosmetic improvement in a blind eye and in unresponsive endophthalmitis.[2]

Enucleation or evisceration, and other ophthalmic surgeries related to the optic nerve, is usually associated with severe postoperative pain that results in patient discomfort and decreased postoperative satisfaction.[3]

Postoperative pain after enucleation and evisceration has generally been managed with the use of systemic perioperative opioids and nonsteroidal anti-inflammatory medications. However, recent publications have reported that delivery of local anesthesia to the retrobulbar space prior to enucleation provided significant control of postoperative pain.[4] Several studies reported the preemptive analgesic effect of retrobulbar block. Yao et al. demonstrated that retrobulbar block as an adjuvant to general anesthesia in pediatric vitreoretinal surgery was safe, reduces the need for intraoperative systemic fentanyl, and provides better control of postoperative pain.[5] Vogt et al. studied the effect of intraoperative retrobulbar block after induction of general anesthesia in patients undergoing
scleral buckling and concluded that the use of combined retrobulbar with general anesthesia resulted in the reduction of postoperative pain and analgesic consumption.\textsuperscript{[6]}

Ketamine is a phencyclidine derivative that was introduced into clinical practice in 1965. It is a noncompetitive N-methyl-D-aspartate (NMDA) receptor antagonist, and has analgesic and antihyperalgesic properties.\textsuperscript{[7]} The analgesic effect of ketamine is attributed to the prevention of central sensitization in dorsal horn neurons; also it prevents pain associated with wind-up effect as it blocks NMDA receptor activation with suppression of exaggerated response to subthreshold painful stimuli.\textsuperscript{[8]}

It was reported that ketamine infusion as a bolus dose followed by low dose infusion 1–6 μg.kg\(^{-1}\).min\(^{-1}\) has antihyperalgesic, analgesic and opioid-sparing effects without elevation of intraocular pressure.\textsuperscript{[9]} Several studies were proved the beneficial effect of a low-dose ketamine in ophthalmic surgery.\textsuperscript{[10]} However, our study is the first study that compared the effect of retrobulbar block versus ketamine infusion as an adjuvant to general anesthesia in eye enucleation or evisceration. We hypothesized that the use of single retrobulbar injection or intravenous (i.v.) low-dose ketamine infusion as an adjuvant to general anesthesia in enucleation or evisceration would be effective in the control of postoperative pain with reduced analgesic consumption.

**Materials and Methods**

Following approval of the trial protocol by the institute’s local research and ethics committee, and registration to clinical trials. gov with ID: NCT03507426, a written informed consent form was obtained from all recruited patients, after being given a full explanation about the experimental procedure. The study was conducted in Kasr Al-Aini Hospital on 45 patients who fell under American Society of Anesthesiologists (ASA) physical status I and II of both sexes, candidate for eye enucleation or evisceration, and aged between 18 and 70 years, with the exclusion of patients having any condition contraindicating regional anesthesia or being allergic to any of the study drugs. Routine preoperative evaluation, including history taking, general examination, and laboratory investigations, was performed for all patients. Patients were randomly allocated using computer (MS Excel model) and opaque-sealed envelopes into one of the three equal groups, 15 patients in each. Patients were blind to the randomized allocation and received general anesthesia alone (Group C), general anesthesia plus retrobulbar block (Group R), or general anesthesia plus ketamine infusion (Group K). In the preparation room, 20G i.v. cannula was inserted using local lidocaine infiltration, and each patient was premedicated with midazolam 2 mg, ranitidine 50 mg, and ondansetron 4 mg. Upon arrival to the operating room, standard monitors including 5-lead electrocardiogram, pulse oximetry, and noninvasive blood pressure were applied. In all patients, general anesthesia was induced (before giving the retrobulbar block or starting either ketamine or placebo infusion) with propofol 2–3 mg.kg\(^{-1}\) and fentanyl 1 μg.kg\(^{-1}\); tracheal intubation was facilitated with atracurium 0.5 mg.kg\(^{-1}\); and mechanical ventilation was adjusted to keep EtCO\(_2\) 30–35 mmHg. Anesthesia was maintained with oxygen: air (50:50%), isoflurane 1.5%, and atracurium 0.1 mg.kg\(^{-1}\) every 20 min. In Group R, after confirmation of the eye to be operated upon, retrobulbar block was given. In supine position with the globe in a neutral gaze position, the lower eye lid was cleaned with an alcohol wipe, 5 cc syringe with a 25G, 1.5” needle was inserted in the inferotemporal quadrant at the junction of the lateral one-third and the medial two-third of the inferior orbital rim pointing perpendicular to the plane of the patient’s face and entered just inferior to the globe. Once the first pop through the orbital septum was felt, the needle was directed with 45° angle medially and superiorly toward the apex of the orbit until the second pop through the muscle cone is felt, the local anesthetic solution (4 mL of a mixture of lidocaine 2% + bupivacaine 0.5% with hyaluronidase 75 IU) was slowly injected after aspiration, and gentle digital massage to promote spread of the local anesthetics was done for 2–3 min. In Group K, Ketamine 100 mg was loaded into a 50 mL syringe (ketamine concentration was 2 mg/mL). After induction of general anesthesia, the patients received i.v. 0.5 mg.kg\(^{-1}\) bolus followed by an infusion of 0.25 mg.kg\(^{-1}\).h\(^{-1}\), continued until completion of the surgical procedure via infusion pump (Perfusor compact, Braun, Germany). In Group C, placebo syringe contained normal saline, labeled similar to the study drug, which was continued with the same rate throughout the procedure. At the end of the surgical procedure, isoflurane was discontinued and the neuromuscular blockade was reversed using neostigmine (0.05 mg.kg\(^{-1}\)) and atropine (0.02 mg.kg\(^{-1}\)), with tracheal extubation upon complete recovery of the reflexes. Intraoperative mean blood pressure and heart rate (MBP and HR) before induction (T0), after induction of retrobulbar block, and starting infusion of either ketamine or placebo (T1), at incision (T2), and every 15 min till the end of the procedure, as well as the recovery time (the time from the end of surgery to achievement conditions of discharge from the postanesthesia care unit [PACU]).

10 cm Visual Analogue Scale (VAS) was assessed by an observer blind to patient’s allocation immediately on arrival to PACU, and at 30 min, 3, 6, 12, and 24 h thereafter, rescue analgesia was given in the form of i.v. paracetamol 100 mg if the VAS was ≥ 4. Intramuscular pethidine 50 mg was given if pain was not controlled or analgesia required before 6 h from the given paracetamol. The time to the first rescue analgesic and number of patients who required rescue analgesia were recorded. Side effects such as nausea, vomiting, hallucination, respiratory depression (respiratory rate < 10/min.) and the level of sedation was assessed by an observer blind to patient’s allocation using the four-point sedation score described by Chernik et al. (0 = awake, 1 = sleeping comfortably and responding to vocal commands, 2 = somnolence, deep sleep but responding to vocal commands, and 3 = not arousable, deep sleep).\textsuperscript{[11]} were monitored.
The primary outcome of the study is the time to first rescue analgesia within the first 24 h.

Sample size
Assuming that a difference of 25% or more in the time to first rescue analgesic between retrobulbar and ketamine group would be of clinical interest and ketamine infusion as adjuvant to general anesthesia would increase the time to first rescue analgesic in comparison to the placebo group, based on the results reported in previous publication. A sample size of 14 patients per group was calculated when we estimated a standard deviation for this prospective study with power analysis 80% at α value of 0.05. The number was increased to 15 to compensate for dropouts. Sample size calculation was done using G∗ power software version 3.1.9.2, Universitat Kiel, Germany.

Statistical methods
Data were coded and entered using the SPSS software (Statistical Package for the Social Science; IBM Corp., Armonk, NY, USA) was used to make statistical calculations. Data were summarized using mean and standard deviation in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. Comparisons between groups were done using ANOVA with post hoc test in normally distributed quantitative variables while nonparametric Kruskal–Wallis test and Mann–Whitney test were used for nonnormally distributed quantitative variables. For comparison of serial measurements within each group repeated measures ANOVA was used. For comparing categorical data, Chi-square test was performed. P < 0.05 was considered statistically significant.

Results
The number of cases that were indicated for enucleation or evisceration were 47 cases, two of them refused to share in the study while 45 were enrolled and randomized to three groups 15 cases in each one [Figure 1]. The three groups were comparable with respect to age, sex, body mass index, ASA physical status, duration, and indication of surgery [Table 1]. MBP and HR values at T0 were comparable in all groups. No statistically significant difference between K and C groups at T1–T2 but values at T3–T5 were significantly lower in K group than C group. MBP and HR values at T1–T2 were significantly higher in K group in comparison to R group, with no statistically significant difference thereafter between both groups. Values of MBP and HR at T1–T5 were significantly lower in R group in comparison to C group [Figures 2 and 3].

No patient experienced intraoperative oculocardiac reflex (OCR) in either R or K group compared to 5 (33.33%) patients in C group (P < 0.05), i.v. atropine was required in three of them. Postoperative VAS score was significantly higher in C group in comparison to R and K groups. No statistically significant difference in VAS score between R and K groups on arrival to PACU (R0), at 30 min (R1) and at 3 h (R2) but the values thereafter (R3–R5) were significantly lower in R group [Table 2]. The recovery time was significantly longer in K group (46.53 ± 4.63 min) in comparison to R (30.87 ± 4.22 min) and C (31.40 ± 4.76 min) group. Also, the postoperative sedation score was significantly higher in K group in comparison to R and C groups with no statistically significant difference between R and C groups. The time to first rescue analgesic was significantly shorter in C group (52.80 ± 7.81 min) in comparison to R (429.17 ± 54.63 min) and K (272.86 ± 34.14 min) groups. Also the time to first rescue analgesic was significantly longer in R group in comparison to K group. The frequency of rescue analgesic was significantly higher in C group [Table 3]. No statistically significant difference was observed between the three groups as regarding incidence of postoperative nausea and vomiting (PONV) [Table 4]. No patient experienced postoperative hallucination or other adverse events [Tables 5 and 6].

Discussion
The present study demonstrated that, retrobulbar block or IV ketamine infusion as adjuvant to general anesthesia in enucleation or evisceration was safe and exhibited better control of postoperative pain with reduced need for postoperative analgesics.

Table 1: Demographic data

|                      | Mean±SD |          |          |          |          |          |          |          |
|----------------------|---------|----------|----------|----------|----------|----------|----------|----------|
|                      | Group R | Group K  | Group C  | Group R versus Group K | Group R versus Group C | Group K versus Group C |          |
| Age (years)          | 59.93±6.57 | 60.20±5.44 | 63.67±5.60 | 1.000 | 0.270 | 0.344 |
| Sex (%)              |         |          |          |          |          |          |          |          |
| Male                 | 11 (73.3) | 12 (80.0) | 11 (73.3) | 1 | 1 | 1 |
| Female               | 4 (26.7)  | 3 (20.0)  | 4 (26.7)  | 0.190 | 0.352 | 1.000 |
| BMI                  | 27.88±3.22 | 25.78±2.56 | 26.12±3.24 | 0.0705 | 1 | 0.705 |
| ASA (%)              |          |          |          |          |          |          |          |          |
| I                    | 5 (33.3)  | 6 (40.0)  | 5 (33.3)  | 1 | 0.641 | 1.000 | 0.787 |
| II                   | 10 (66.7) | 9 (60.0)  | 10 (66.7) | 1 | 1 | 1 |
| Duration of surgery (min) | 56.33±6.17 | 53.67±5.35 | 56.07±5.80 | 0.0705 | 1 | 0.705 |
| Enucleation (%)      | 12 (80.0) | 11 (73.3) | 11 (73.3) | 1 | 1 | 1 |
| Evisceration (%)     | 3 (20.0)  | 4 (26.7)  | 4 (26.7)  | 1 | 1 | 1 |

No statistically significant difference between the groups P>0.05. Group R=Retrobulbar, Group K=Ketamine, Group C=Control group (saline), SD=Standard deviation, BMI=Body mass index, ASA=American society of anesthesiologist
Previous studies investigated the factors associated with increased risk of postoperative pain after ophthalmic surgery, and reported that patients who had surgery under general anesthesia alone experienced serious postoperative pain compared to regional anesthesia. 

The use of adjuvant analgesics such as regional block, systemic drugs as; nonsteroidal anti-inflammatory drug, NAMDA-receptor blockers and α2 agonists is one way to increase the duration of postoperative pain relief, reduce opioid requirements and their side effects, with better recovery, and reduced duration of hospital stay. 

The results of our study demonstrated that; the intraoperative use of single retrobulbar injection or i.v. ketamine 0.5 mg.kg⁻¹ bolus followed by infusion of 0.25 mg.kg⁻¹.h⁻¹ as adjuvant to general anesthesia associated with a significantly lower postoperative VAS score at all time-points of measurement and reduced analgesic consumption in the first 24 h in comparison to the control group. Only 4 (26.7%) of 15 patients and 7 (46.7%)
Table 3: Heart rate

|                  | Mean±SD          | P             |
|------------------|------------------|---------------|
|                  | Group R          | Group K       | Group C       |
| Baseline HR      | 81.40±13.08      | 84.33±9.08    | 83.73±7.45    | 1.000          | 1.000          | 1.000          |
| HR (T0)          | 74.00±12.50      | 79.20±8.78    | 81.07±7.54    | 0.465          | 0.167          | 1.000          |
| HR (T1)          | 70.00±10.45      | 87.53±7.38    | 80.53±8.37    | <0.001*        | 0.006*         | 0.107          |
| HR (T2)          | 68.27±10.32      | 81.67±6.06    | 82.00±5.55    | <0.001*        | <0.001*        | 1.000          |
| HR (T3)          | 64.93±9.67       | 72.60±11.11   | 82.93±4.79    | 0.071          | <0.001*        | 0.009*         |
| HR (T4)          | 64.80±9.34       | 71.53±10.93   | 83.07±5.62    | 0.134          | <0.001*        | <0.001*        |
| HR (T5)          | 66.27±7.51       | 71.73±9.86    | 84.73±3.69    | 0.154          | <0.001*        | <0.001*        |

*Statistically significant. Group R=Retrobulbar, Group K=Ketamine, Group C=Control group (saline), T0=Before induction, T1=Immediate after induction of retrobulbar and ketamine infusion, T2=At incision, T3–T5=At 15 min intervals, SD=Standard deviation, HR=Heart rate

Table 4: Postoperative visual analogue scale

|                  | Mean±SD          | P             |
|------------------|------------------|---------------|
|                  | Group R          | Group K       | Group C       |
| V AS on arrival to PACU (R0) | 0.20±0.41 | 0.33±0.49 | 1.20±0.77 | 1.000 | <0.001* | 0.001* |
| 30 min V AS (R1) | 0.80±0.56 | 0.80±0.77 | 2.73±0.80 | 1.000 | 0.000* | <0.001* |
| 3 h V AS (R2)    | 1.67±0.49 | 1.60±0.74 | 4.07±1.16 | 1.000 | <0.001* | <0.001* |
| 6 h V AS (R3)    | 1.87±0.35 | 2.60±0.91 | 3.33±0.82 | 0.027* | <0.001* | 0.027* |
| 12 h V AS (R4)   | 2.40±0.51 | 3.33±0.90 | 4.47±1.06 | 0.014* | <0.001* | 0.002* |
| 24 h V AS (R5)   | 3.07±0.80 | 3.93±1.10 | 5.13±0.92 | 0.048* | <0.001* | <0.001* |

*Statistically significant (P<0.05). V AS=Visual analogue scale (cm), SD=Standard deviation, PACU=Postanaesthetic care unit, Group R=Retrobulbar, Group K=Ketamine, Group C=Control group (saline)

Table 5: Recovery time, rescue analgesia and level of sedation using four-point sedation score

|                  | Mean±SD          | P             |
|------------------|------------------|---------------|
|                  | Group R          | Group K       | Group C       |
| Recovery time (min) | 30.87±4.22 | 46.53±4.63 | 31.40±4.76 | <0.001* | 1.000 | <0.001* |
| Time to first rescue analgesic (min) | 429.17±54.63 | 272.86±34.14 | 52.80±7.81 | <0.001* | <0.001* | <0.001* |
| Rescue analgesia within 12 h (%) | 11 (73.3) | 8 (53.3) | 0 (0.0) | 0.256 | <0.001* | 0.001* |
| Sedation score (%) | 12 (80.0) | 5 (33.3) | 11 (73.3) | 0.022* | 1 | 0.031* |
| 2                | 3 (20.0) | 6 (40.0) | 4 (26.7) |
| 3                | 0 (0.0)  | 4 (26.7) | 0 (0.0)  |

*Statistically significant (P<0.05). Group R=Retrobulbar, Group K=Ketamine, Group C=Control group (Saline), SD=Standard deviation

of 15 patients required once rescue i.v. paracetamol in retrobulbar and ketamine groups respectively but in the control group 11 (73.3%) patients required once and 4 (26.7%) required twice rescue i.v. paracetamol. Also, the mean time to first rescue analgesic was significantly prolonged in retrobulbar (429.17±54.63 min), and ketamine (272.86±34.14 min) in comparison to the control group (52.80±7.81 min).

The results of our study are in agreement with that of Bowyer et al., who studied the effect of retrobulbar block as adjuvant to general anesthesia in eye enucleation with primary orbital implant insertion and concluded that; the retrobulbar block was safe and effective in control of postoperative pain without reported complications.[15]

The findings of our study are in line with that of Bota et al., which showed that; the use of ketamine as a bolus dose of 0.5 mg.kg⁻¹ at induction of general anesthesia followed by infusion of 0.1 mg.kg⁻¹.h⁻¹ intraoperative and for 24 h postoperative in eye enucleation or evisceration reduces postoperative pain and analgesic consumption.[16] Bota et al. is different from our study as they continued ketamine infusion for 24 h postoperative, but they reported development of agitation in one patient, and noticed the long stay of patients in bed during...
In contrast, Abdolahi et al. reported that the use of low-dose 0.5 mg.kg⁻¹ ketamine during induction of anesthesia in patients undergoing retinal detachment, strabismus, and keratoplasty showed no significant effect on postoperative pain, or analgesic consumption. This difference may be due to the dose-dependent effect; in our study, we used a bolus dose 0.5 mg.kg⁻¹ followed by infusion of 0.25 mg.kg⁻¹.h⁻¹.

In the present study, we found that the analgesic effect of retrobulbar block is superior to that of i.v. ketamine infusion, with significantly lower VAS at 3, 6, 12, and 24 h. The mean time to first rescue analgesic was significantly longer with decreased postoperative consumption of paracetamol analgesia in comparison to i.v. ketamine. In line with our findings, Oel et al. demonstrated that retrobulbar block during eye enucleation can prevent the decrease in HR associated with the initiation of the OCR.

The present study showed intraoperative more cardiovascular stability in retrobulbar and ketamine group. No patient in retrobulbar or ketamine groups experienced intraoperative OCR compared to 5 (33.33%) patients in the control group; three of them required i.v. atropine. The results of our study are supported by the results of Yeatts et al. which showed that preemptive retrobulbar analgesia in 69 patients scheduled for eye enucleation provided stable intraoperative hemodynamics and reduced postoperative pain and analgesic consumption. In contrast, Griffis reported the development of hypotension and bradycardia that corrected with vasopressors administration in an elderly diabetic male with few apparent cardiovascular

The current study is the first study comparing the analgesic effect of i.v. ketamine versus regional block in ophthalmic surgery, but Karadeniz et al. studied the effect of preemptive i.v. ketamine versus caudal block as adjuvant to general anesthesia in pediatric patients undergoing inguinal hernia and concluded that the preemptive caudal block provides better intra and postoperative pain relief than i.v. ketamine. The present study showed intraoperative more cardiovascular stability in retrobulbar and ketamine group. No patient in retrobulbar or ketamine groups experienced intraoperative OCR compared to 5 (33.33%) patients in the control group; three of them required i.v. atropine.

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complications when he received a single retrobulbar injection as adjuvant to general anesthesia during enucleation. But Griffis, attributed these effects to inadequate sympathetic tone rather than OCR and concluded that; the possibility of hypotension in similar conditions should be considered and to lessened anesthetic requirements if a combination of retrobulbar block with general anesthesia is planned.\cite{21}

The results of our study are in line with that of Saxena et al. which demonstrated that ketamine in a dose of 0.5 mg.kg\(^{-1}\) preoperatively followed by repeated doses of 0.25 mg.kg\(^{-1}\) every ½ h in patients undergoing laparoscopic gynecological surgery provided stable intraoperative hemodynamics.\cite{22}

Choi et al. demonstrated that the use of ketamine for maintenance of anesthesia is associated with a lower incidence of OCR, as it has sympathomimetic effect and inhibits the parasympathetic reflex.\cite{23}

In contrast Oh et al. showed that the use of ketamine 1.0 mg kg\(^{-1}\) for induction of anesthesia in pediatric strabismus surgery does not reduce the incidence of OCR compared with midazolam.\cite{24}

This difference explained by the dose of ketamine used, as Choi et al. found that; the increased dose of ketamine associated with reduced incidence of OCR.

In the current study, we found that the postoperative sedation score was significantly higher in ketamine group, also the recovery time was significantly longer in ketamine group in comparison to retrobulbar and control groups, which is consistent with the previous reports.\cite{25}

Based on the results of our study the use of combined retrobulbar block with general anesthesia reduces the incidence of PONV in comparison to general anesthesia alone. These results are explained by the control of postoperative pain, which is a risk factor for the development of PONV, as well as the reduced need of postoperative narcotics analgesia.\cite{26} The block of OCR by the retrobulbar injection may play a role, as the previous studies found a significant association between the occurrence of an intra-operative OCR and PONV.\cite{27}

We found that the use of combined general anesthesia with low dose ketamine infusion associated with decreased incidence of PONV which is explained by inhibition of the effenter pathway of the oculogastric reflex.\cite{24} However, the difference between the groups of our study as regarding the incidence of PONV was statistically nonsignificant (\(P > 0.05\)).

In the present study, no patient developed postoperative hallucination. We found that the use of low dose ketamine 0.25 mg.kg\(^{-1}\).h\(^{-1}\) is not associated with the incidence of postoperative hallucination. Our results supported by previous studies that reported the analgesic effect of ketamine with minimal side effects when used in sub-anesthetic dose (\(\leq 0.3 \text{mg.kg}^{-1}\).h\(^{-1}\) i.v.) for acute perioperative pain.\cite{28}

In spite of general anesthesia remains the most commonly used technique of anesthesia in enucleation and evisceration, it provides more comfort especially in young patients. Several studies were done to assess the efficacy and outcome of eye amputation under local anesthesia. Calenda et al. concluded that peribulbar anesthesia is a safe technique to be used for enucleation or evisceration and provides proper postoperative analgesia with reduced postoperative analgesic consumption.\cite{29} Further studies required to assess the possibility of using retrobulbar block alone or in combination with low dose ketamine infusion for anesthesia in patients undergoing enucleation or evisceration.

The relatively small number of patients included in the study and the inability to assess VAS after 24 h to evaluate whether chronic pain was reduced with administration of intraoperative retrobulbar block or low-dose ketamine infusion can be considered as limitations of the current study.

**Conclusions**

Intraoperative single retrobulbar injection is superior to low-dose ketamine infusion in control of postoperative pain after enucleation or evisceration, with significantly prolonged time to first rescue analgesia, reduced analgesic consumption, lower sedation score, and recovery time.

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**Conflicts of interest**

There are no conflicts of interest.

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