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# Comparative effectiveness of lidocaine with and without adrenaline on hemodynamic stability and anesthetic outcomes in Libyan patients undergoing ophthalmic surgery

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**Abstract**: Local anesthesia is widely used in ophthalmic surgery to provide effective analgesia and akinesia. This study aimed to compare the effectiveness and safety of lidocaine mixed with adrenaline versus lidocaine alone during ophthalmic surgery. A comparative observational study was conducted between January and May 2026 at the Noor Al-Khaleej Medical Center, Anwar Al-Khaleej Medical Center in Zawia, Surman Teaching Hospital, Surman Central Hospital, Al-Ajilat Eye Hospital, Zawia Al-Dahmani Eye Hospital - Tripoli, and Royal Clinic - Zawia. A total of 44 Libyan patients were included: Group A received lidocaine mixed with adrenaline (n = 22) and Group B received lidocaine alone (n = 22). Surgery duration was significantly shorter in Group A (27.50 vs. 41.14 min; p = 0.001). Preoperative and postoperative blood pressure and preoperative blood glucose were comparable between the groups, whereas postoperative blood glucose was significantly higher in Group A (135.32 vs. 107.73 mg/dL; p = 0.010). Analgesia and central eye position were similar in both groups. Group A demonstrated significantly better eye akinesia (81.8% vs. 45.5%; p = 0.022), body akinesia (54.5% vs. 31.8%; p = 0.028), and combined eye and body akinesia (68.2% vs. 22.7%; p = 0.006). No significant differences were observed in intraoperative complications, including chemosis, subconjunctival hemorrhage, iris prolapse, or corneal edema. In conclusion, adding adrenaline to lidocaine enhanced motor blockade and shortened surgical duration while maintaining a safety profile comparable to that of lidocaine alone during ophthalmic surgery.

## Introduction

Ophthalmic surgery is one of the most commonly performed surgical specialties worldwide, with continuous advances in microsurgical techniques contributing to improved visual outcomes and shorter operative times. These developments have increased the demand for anesthetic techniques that provide effective analgesia, adequate ocular akinesia, rapid postoperative recovery, and a high level of patient safety [1]. Consequently, local and regional anesthesia have become the preferred anesthetic approaches for most ophthalmic procedures because they minimize systemic complications while ensuring optimal surgical conditions [2]. Among regional anesthetic techniques, the peribulbar block is widely used owing to its ability to provide reliable sensory anesthesia and satisfactory globe akinesia with a lower risk of serious complications than retrobulbar anesthesia [3, 4]. Lidocaine remains the most frequently used local anesthetic because of its rapid onset and favorable safety profile [5, 6]. However, its relatively short duration of action and rapid systemic absorption have prompted the use of pharmacological adjuvants, particularly adrenaline, to prolong anesthetic duration, reduce systemic absorption through vasoconstriction, improve motor blockade, and optimize the surgical field by reducing local bleeding [7, 8]. Although the addition of adrenaline to lidocaine is widely practiced in ophthalmic anesthesia, the reported clinical benefits remain inconsistent. Previous studies have mainly focused on individual outcomes such as pain control, onset of anesthesia, or specific surgical techniques, whereas comprehensive evaluations of perioperative clinical parameters, anesthetic effectiveness, and intraoperative complications remain limited. Furthermore, evidence directly comparing lidocaine with adrenaline and lidocaine alone in patients undergoing ophthalmic surgery is still relatively scarce [9, 10]. Therefore, the present study aimed to compare lidocaine mixed with adrenaline and lidocaine alone in patients undergoing ophthalmic surgery by evaluating perioperative clinical parameters, anesthetic effectiveness, and intraoperative complications to determine whether the addition of adrenaline provides clinically significant advantages over the use of lidocaine alone.

## Methods and materials

*Study design and setting:* This comparative observational study was conducted to evaluate the clinical effectiveness and safety of lidocaine mixed with adrenaline compared with lidocaine for local anesthesia during ophthalmic surgery. The study was carried out at the Noor Al-Khaleej Medical Center, Anwar Al-Khaleej Medical Center in Zawia, Surman Teaching Hospital, Surman Central Hospital, Al-Ajilat Eye Hospital, Zawia Al-Dahmani Eye Hospital in Tripoli, and Royal Clinic in Zawia, from January to May 2026.

*Study population:* The study included patients undergoing ophthalmic surgery during the study period. Participants were classified into two groups according to the local anesthetic regimen routinely administered during surgery. Group A consisted of patients who received lidocaine mixed with adrenaline, whereas Group B included patients who received lidocaine alone. Since this was an observational study, no random allocation of participants was performed.

*Anesthetic procedure and clinical assessment:* All patients underwent ophthalmic surgery under local anesthesia according to the standard surgical protocol of the participating hospitals. Preoperative evaluation included the measurement of systolic blood pressure, diastolic blood pressure, and blood glucose. The same parameters were reassessed immediately after surgery. In addition, the duration of surgery was recorded for each patient. The quality of local anesthesia was evaluated intraoperatively using standardized clinical criteria. The assessed outcomes included analgesia, central eye position, eye akinesia, body akinesia, and combined eye and body akinesia. Each parameter was graded as excellent, good, or average based on the surgeon's intraoperative assessment. To evaluate the safety of the anesthetic techniques, intraoperative complications were systematically recorded, including chemosis, subconjunctival hemorrhage, combined chemosis and subconjunctival hemorrhage, combined chemosis, periorbital hematoma, subconjunctival hemorrhage, iris prolapse, and corneal edema.

*Ethical considerations:* The protocol was approved by the Institutional Ethics Committees of the participating hospitals in 12/2025. Written informed consent was also obtained from the participants. Participant confidentiality and privacy were strictly maintained by anonymizing all collected data (021-MJ-MJMR-2026).

*Statistical analysis:* The analysis was performed using IBM SPSS Statistics for Windows, version 21.0. Continuous variables were expressed as mean ± standard deviation together with minimum and maximum values, while categorical variables were presented as frequencies and percentages. Differences between the two groups for continuous variables were analyzed using the independent samples *t*-test. Categorical variables were compared using Fisher's exact test. Statistical significance was defined as a two-sided p-value $< 0.05$, whereas $p < 0.01$ indicated a highly significant difference.

## Results

A total of 44 Libyan patients were included in the study and equally allocated into two groups. Group A consisted of 22 patients who received lidocaine mixed with adrenaline, whereas Group B included 22 patients who received lidocaine alone. As presented in **Table 1**, patients receiving lidocaine mixed with adrenaline had a significantly shorter mean duration of surgery than those receiving lidocaine alone (27.50 ± 6.15 vs. 41.14 ± 17.32 minutes; $p < 0.001$). On other hand, no significant differences were observed between the two groups in preoperative systolic blood pressure (129.23 vs. 129.55 mmHg; $p = 0.934$), preoperative diastolic blood pressure (80.91 vs. 81.36 mmHg; $p = 0.808$), postoperative systolic blood pressure (125.77 vs. 123.41 mmHg; $p = 0.404$), postoperative diastolic blood pressure (80.05 vs. 79.68 mmHg; $p = 0.843$), or preoperative blood glucose levels (129.14 vs. 112.64 mg/dL; $p = 0.110$). In contrast, postoperative blood glucose was significantly higher in the lidocaine mixed with adrenaline group than in the lidocaine group (135.32 vs. 107.73 mg/dL; $p = 0.010$).

**Table 1.** Comparison of clinical parameters between patients receiving lidocaine mixed with adrenaline and lidocaine

| Items | Type of anesthesia drug | | | | | | | | p-value |
|---|---|---|---|---|---|---|---|---|---|
| | Lidocaine with adrenaline | | | | Lidocaine | | | | |
| | Max | Min | Mean | SD | Max | Min | Mean | SD | |
| Duration of surgery | 40.0 | 15.0 | 27.50 | 6.15 | 60 | 10 | 41.14 | 17.32 | **0.001**** |
| Preoperative systolic | 155.0 | 110.0 | 129.23 | 12.60 | 160 | 110 | 129.55 | 12.81 | 0.934 |
| Preoperative diastolic | 90.0 | 60.0 | 80.91 | 7.03 | 90 | 70 | 81.36 | 5.16 | 0.808 |
| Postoperative systolic | 145.0 | 110.0 | 125.77 | 9.29 | 140 | 110 | 123.41 | 9.31 | 0.404 |
| Postoperative diastolic | 90.0 | 60.0 | 80.05 | 6.92 | 90 | 65 | 79.68 | 5.01 | 0.843 |
| Preoperative blood sugar | 270.0 | 79.0 | 129.14 | 43.66 | 180 | 90 | 112.64 | 18.31 | 0.110 |
| Postoperative blood sugar | 271.0 | 76.0 | 135.32 | 44.81 | 160 | 80 | 107.73 | 17.78 | **0.001**** |

Independent samples test. * Significant at the 0.05 level. ** Highly significant at the 0.01 level.

**Table 2.** Comparison of anesthetic effectiveness according to type of anesthesia drug

| Items | | Type of anesthesia drug | | | | p-value |
|---|---|---|---|---|---|---|
| | | Lidocaine with adrenaline | | Lidocaine | | |
| | | N | % | N | % | |
| **Analgesia** | Excellent | 20 | 90.9 | 18 | 81.8 | 0.664 |
| | Good | 02 | 09.1 | 04 | 18.2% | |
| | Average | 00 | 00.0 | 00 | 00.0 | |
| **Eye position central** | Excellent | 16 | 72.7 | 14 | 63.6 | 0.747 |
| | Good | 06 | 27.3 | 07 | 31.8 | |
| | Average | 00 | 00.0 | 01 | 04.5 | |
| **Akinesia of the eye** | Excellent | 18 | 81.8 | 10 | 45.5 | **0.022*** |
| | Good | 03 | 13.6 | 11 | 50.0 | |
| | Average | 01 | 04.5 | 01 | 04.5 | |
| **Akinesia of the body** | Excellent | 12 | 54.5 | 07 | 31.8 | **0.028*** |
| | Good | 10 | 45.5 | 09 | 40.9 | |
| | Average | 0 | 00.0 | 06 | 27.3 | |
| **Akinesia of the eye and body** | Excellent | 15 | 68.2 | 05 | 22.7 | **0.006**** |
| | Good | 07 | 31.8 | 15 | 68.2 | |
| | Average | 00 | 00.0 | 02 | 09.1 | |

p-value is determined using Fisher's Exact test. * Significant at the 0.05 level. ** Highly significant at the 0.01 level

In both groups, similarly favorable analgesia was achieved as shown in **Table 2**, with excellent analgesia observed in 90.9% and 81.8% of patients receiving lidocaine mixed with adrenaline and lidocaine alone, respectively ($p = 0.664$). Likewise, central eye position was comparable between the two groups (72.7% vs. 63.6%; $p = 0.747$). However, significantly higher rates of excellent eye akinesia (81.8% vs. 45.5%; $p = 0.022$), body akinesia (54.5% vs. 31.8%; $p = 0.028$), and combined eye and body akinesia (68.2% vs. 22.7%; $p = 0.006$) were observed in patients receiving lidocaine mixed with adrenaline, demonstrating superior motor blockade with the addition of adrenaline.

Regarding intraoperative complications, no statistically significant differences were observed between the two groups in the incidence of chemosis (4.5% vs. 22.7%; $p = 0.185$), subconjunctival hemorrhage (4.5% vs. 4.5%; $p = 1.000$), combined chemosis and subconjunctival hemorrhage (4.5% vs. 9.1%; $p = 1.000$), iris prolapse (0% vs. 9.1%; $p = 0.488$), or corneal edema (13.6% vs. 18.2%; $p = 1.000$). These findings indicate that both anesthetic techniques demonstrated comparable intraoperative safety profiles without significant differences in the recorded complications (**Table 3**).

**Table 3:** Comparison of intraoperative complications according to type of anesthesia drug

| Items | | Type of anesthesia drug | | | | p-value |
|---|---|---|---|---|---|---|
| | | Lidocaine with adrenaline | | Lidocaine | | |
| | | N | % | N | % | |
| Chemosis | Yes | 01 | 04.5 | 05 | 22.7 | 0.185 |
| | No | 21 | 95.5 | 17 | 77.3 | |
| Subconjunctival hemorrhage | Yes | 01 | 4.5 | 01 | 04.5 | 1.00 |
| | No | 21 | 95.5 | 21 | 95.5 | |
| Chemosis, Subconjunctival hemorrhage | Yes | 01 | 4.5 | 02 | 09.1 | 1.00 |
| | No | 21 | 95.5 | 20 | 90.9 | |
| Iris prolapses | Yes | 00 | 0.0 | 02 | 9.1 | 0.488 |
| | No | 22 | 100.0 | 20 | 90.9 | |
| Corneal edema | Yes | 03 | 13.6 | 04 | 18.2 | 1.00 |
| | No | 19 | 86.4 | 18 | 81.8 | |

p-value is determined using Fisher's Exact Test (no significant difference)

## Discussion

The present study compared the clinical outcomes of lidocaine combined with adrenaline versus lidocaine alone in patients undergoing ophthalmic surgery. The findings suggest that the addition of adrenaline was associated with improved anesthetic performance, particularly by enhanced motor blockade and reduced the duration of surgery, without adversely affecting perioperative hemodynamic stability. Although most clinical parameters were similar between the two groups, lidocaine combined with adrenaline was associated with a significantly shorter surgical duration, suggesting improved operating conditions resulting from more effective anesthesia. The absence of significant differences in systolic and diastolic blood pressure between the two groups confirms the cardiovascular safety of adding adrenaline at the concentration used in the present study. The vasoconstrictive effect of adrenaline prolongs the local action of lidocaine by reducing vascular absorption while producing minimal systemic hemodynamic effects. These findings are consistent with Ramalingam et al. [10], who demonstrated that lidocaine combined with adrenaline achieved faster anesthetic onset, improved surgical conditions, and maintained stable blood pressure compared with plain lidocaine. Similarly, Han et al. [11] reported that although adrenaline-containing lidocaine formulations may increase discomfort during injection, they do not produce clinically significant cardiovascular adverse effects, supporting the favorable safety profile observed in the current study.

About anesthetic effectiveness, the present study demonstrated significantly better ocular, body, and combined akinesia in the lidocaine-adrenaline group, whereas analgesia and central eye position remained comparable between the two techniques. These findings suggest that adrenaline primarily enhances the motor component of regional anesthesia by prolonging local anesthetic activity, thereby improving surgical conditions without affecting sensory blockade. Similar observations were reported by Pucchio et al. [1], who emphasized that successful regional ophthalmic anesthesia should provide both effective analgesia and adequate akinesia to facilitate precise ocular surgery. Likewise, Jacobi et al. [12] demonstrated that satisfactory ocular akinesia is essential for maintaining optimal operating conditions during ophthalmic procedures. Furthermore, systematic reviews and network meta-analyses have demonstrated that regional anesthetic techniques achieving superior akinesia improve surgical comfort and reduce the need for supplemental anesthesia, reinforcing the clinical importance of effective motor blockade during ophthalmic procedures [9, 13]. In contrast, the comparable analgesic outcomes observed in both groups agree with Davis et al. [14], who found that different lidocaine-based anesthetic formulations provide similar levels of pain control despite differences in anesthetic technique.

Most intraoperative complications were comparable between the two anesthetic groups. Patients receiving lidocaine with adrenaline showed a lower incidence of chemosis, combined chemosis and subconjunctival hemorrhage, iris prolapse, and corneal edema, although this difference was not statistically significant. These findings suggest that the addition of adrenaline did not increase the risk of local intraoperative complications in the studied population. Previous reports have indicated that complications associated with regional ophthalmic anesthesia are uncommon and are influenced by several factors, including anesthetic technique, injection volume, and patient characteristics rather than the anesthetic agent alone [15, 16]. Collectively, these findings suggest that the addition of adrenaline to lidocaine enhances anesthetic quality while maintaining an acceptable safety profile, supporting its routine use in ophthalmic regional anesthesia.

*Conclusion:* The addition of adrenaline to lidocaine improved anesthetic outcomes during ophthalmic surgery by providing more effective motor blockade, particularly for body and combined eye-body akinesia, without significantly affecting hemodynamic stability or other perioperative clinical parameters. Therefore, lidocaine combined with adrenaline appears to be an effective and safe option for ophthalmic surgery.

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