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Enhancing Patient Comfort and Anaesthetic Efficacy in Upper-Eyelid Blepharoplasty: A Randomised Controlled Trial of Sodium Bicarbonate-Buffered Lidocaine

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ABSTRACT

Background: Pain during local anaesthetic injection is a major concern for patients undergoing upper-eyelid blepharoplasty. Buffered lidocaine, adjusted with sodium bicarbonate, has been proposed to reduce injection discomfort and improve anaesthetic efficacy.

Aim: To evaluate the effects of sodium bicarbonate-buffered lidocaine on pain perception, anaesthetic onset, efficacy, and surgical outcomes in blepharoplasty.

Methods: A double-blind, randomised controlled trial was conducted among 124 adult patients undergoing upper-eyelid blepharoplasty at Alhokail Eye Center, Dammam. Participants were randomly assigned to receive either 2% lidocaine with epinephrine or the same solution buffered with 8.4% sodium bicarbonate (1:5 ratio). Primary outcomes included pain during injection (measured using a 100-mm visual analogue scale) and anaesthesia onset time. Secondary outcomes comprised anaesthetic volume used, duration of analgesia, intraoperative bleeding, postoperative ecchymosis, oedema, and satisfaction ratings.

Results: Buffered lidocaine significantly reduced injection pain (mean VAS: 21.7 vs. 38.4 mm, $p<0.001$) and accelerated anaesthetic onset (mean: 68.7 vs. 94.2 seconds, $p<0.001$). It also required less anaesthetic volume (3.8 vs. 4.4 mL, $p<0.001$) and yielded higher patient (9.1 vs. 8.2, $p<0.001$) and surgeon satisfaction (4.7 vs. 4.1, $p<0.001$). No significant differences were observed in intraoperative bleeding or postoperative complications.

Conclusion: Buffering lidocaine with sodium bicarbonate significantly enhances anaesthetic performance and patient experience during blepharoplasty without compromising safety. This low-cost, simple intervention should be considered in clinical practice.

KEYWORDS: *Buffered lidocaine; sodium bicarbonate; blepharoplasty; local anaesthesia; pain management; patient satisfaction; oculoplastic surgery*

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1. INTRODUCTION

Blepharoplasty is one of the most frequently performed facial plastic procedures worldwide, undertaken for both functional and aesthetic reasons [1]. Although general anaesthesia is an option, the contemporary trend is to favour local infiltration anaesthesia because it reduces peri-operative morbidity, shortens recovery, and lowers costs while allowing patients to maintain airway reflexes and haemodynamic stability [2] . Despite these advantages, many candidates remain apprehensive, chiefly because of the burning pain that accompanies injection of acidic lignocaine (lidocaine) solutions. Fear of this initial discomfort is known to deter some patients from office-based eyelid surgery or push surgeons to employ unnecessary sedation or general anaesthesia, thereby increasing risk and resource utilisation [3].

Lidocaine’s analgesic action depends on its ability to cross neuronal membranes in its non-ionised (base) form, yet

commercial preparations are formulated as hydrochloride salts with a pH between 3.3 and 5.5 to enhance stability and shelf-life [4]. At this acidic pH most molecules are ionised (charged), meaning a larger fraction cannot traverse lipid membranes. The low pH therefore serves a double disadvantage: it delays onset of anaesthesia and causes an intense stinging sensation on infiltration that patients perceive as pain[5]. Raising the pH of the injectate toward physiological levels (≈ 7.4) increases the proportion of non-ionised drug, accelerates neural penetration, and theoretically reduces injection pain. Sodium bicarbonate ($NaHCO_3$) is inexpensive, readily available, and for decades has been used to buffer lignocaine in emergency medicine, dentistry, and dermatologic surgery [6]. The commonly recommended ratio is 1 mL of 8.4 % $NaHCO_3$ to 5 mL of 2 % lidocaine with adrenaline (epinephrine), yielding a pH of approximately 7.2 without precipitating the vasoconstrictor [7].

Early work by Arndt et al. demonstrated that buffering reduced the subjective pain of cutaneous infiltration in dermatological procedures [8]. Subsequent ophthalmic studies have largely echoed these findings. Welch and colleagues, in a double-blind bilateral eye comparison, reported significantly lower pain scores when buffered lidocaine was injected for periocular anaesthesia [9]. Timlin et al. found a shorter onset and adequate haemostasis during upper eyelid surgery without compromising operative field clarity [10] . A 2023 randomised controlled trial in 60 patients undergoing upper eyelid blepharoplasty confirmed that buffered anaesthetic resulted in lower visual analogue pain scores, faster sensory block establishment, and reduced total anaesthetic volume, with no increase in intraoperative bleeding or postoperative bruising [11].

Not all investigations, however, have reached the same conclusion. Narváez et al. conducted a prospective trial in which buffered and non-buffered lidocaine (1 % with epinephrine) produced statistically comparable pain scores ($p = 0.06$) and no differences in postoperative oedema or ecchymosis [12]. Methodological differences—including variations in buffering ratios, injection speed, needle gauge, or the timing of pain assessment—may account for these inconsistent results. In addition, some authors have expressed concern that elevating pH could destabilise adrenaline, shortening its vasoconstrictive effect and thereby increasing blood loss [13]. Pharmacokinetic analyses suggest that clinically relevant adrenaline degradation occurs only after several hours; solutions used within minutes of preparation maintain both pH elevation and vasoconstrictive potency [14]. Large dermatological series have similarly confirmed microbiological and chemical stability of freshly buffered mixtures for up to 24 hours [15].

Systematic reviews aggregating diverse surgical settings lend weight to the analgesic benefit of buffering. Davies et al. analysed 23 trials across dental, dermatological, and obstetric populations and found a consistent reduction in infiltration pain without compromising block quality or duration [16]. More recently, a network meta-analysis focusing on periocular surgery ranked bicarbonate-buffered lidocaine as the most effective strategy for minimising injection discomfort compared with temperature modulation or alternative anaesthetic formulations [17]. Nevertheless, much of the evidence pool is heterogeneous, and high-quality, blepharoplasty-specific data remain sparse. Many studies are underpowered, use subjective outcome measures, or fail to blind either patients or injectors, raising the possibility of performance bias [18].

The clinical relevance of reducing injection pain extends beyond momentary patient comfort. Observational research indicates that negative memories of the infiltration phase are strongly associated with lower satisfaction scores and diminished willingness to undergo future procedures under local anaesthesia [19]. In settings where bilateral surgery is staged, heightened pain during the first eye can increase anxiety before contralateral surgery and has been linked to higher intra-operative blood pressure and heart rate [20]. From the surgeon's perspective, faster onset of sensory block can shorten operative time, while smaller total anaesthetic volumes may lower the risk of tissue distortion, ecchymosis, or inadvertent orbital diffusion [21].

Despite widespread anecdotal endorsement, no consensus guideline currently mandates buffering for periocular anaesthesia, and practice patterns vary significantly across institutions. The Royal College of Ophthalmologists' latest perioperative recommendations cite insufficient blepharoplasty-specific evidence to endorse routine buffering, emphasising the need for robust, procedure-focused trials that include objective haemostatic and aesthetic end-points. Additionally, previous studies have rarely explored patient-reported outcome measures (PROMs) such as procedure-related anxiety, satisfaction, or quality-of-life impact—domains now considered essential in cosmetic surgery research [22].
Given these knowledge gaps, the present study was designed to evaluate the effect of sodium bicarbonate-buffered lidocaine with epinephrine on pain perception, onset and duration of anaesthesia, injected volume, surgical field quality, and early postoperative outcomes in upper eyelid blepharoplasty. We hypothesised that buffering would (1) lower immediate pain scores during infiltration, (2) shorten time to surgical anaesthesia, and (3) achieve equivalent or superior intra-operative haemostasis without increasing complications. By employing a randomised, double-blind methodology, standardised pain assessment tools, and both clinician- and patient-centred outcome measures, we aim to provide high-level evidence to inform perioperative analgesic protocols and improve patient experience in eyelid surgery.

2. MATERIALS AND METHODS

2.1 Study design

A prospective, parallel-group, double-blind, randomised controlled trial was undertaken to compare buffered versus non-buffered lidocaine for upper-eyelid blepharoplasty. Randomisation (1:1 allocation) was computer-generated in variable block sizes of four and six, prepared by an independent statistician, and concealed in consecutively numbered, opaque, sealed envelopes. Surgeons, patients, nursing staff, and outcome assessors remained unaware of group assignment throughout enrolment, intervention, and follow-up.

2.2 Setting

The trial was conducted between March 2024 and January 2025 in Alhokail eye center, dammam. This ambulatory centre serves university staff, students, and their dependents and performs approximately 450 oculoplastic procedures annually. All anaesthetic preparations were mixed in a dedicated clean room adjoining the operating suite, which maintains positive-pressure laminar airflow and temperature control (21 ± 1 °C).

2.3 Sample and sampling

2.3.1 Eligibility criteria

Adults aged 18–70 years scheduled for bilateral upper-lid skin-only blepharoplasty under local anaesthesia were eligible. Exclusion criteria were (i) known allergy to amide anaesthetics or sodium bicarbonate, (ii) current anticoagulant therapy, (iii) uncontrolled systemic disease (American Society of Anesthesiologists class ≥ III), (iv) pregnancy or lactation, (v) previous eyelid surgery or trauma, and (vi) inability to comprehend the 100-mm visual analogue scale (VAS).

2.3.2 Sampling strategy and sample size

Consecutive eligible patients were approached during pre-operative assessment and enrolled after written informed consent. Sample size was calculated using G*Power (version 3.1). Assuming a mean VAS difference of 15 mm (SD 25 mm) based on prior periocular studies , $\alpha = 0.05$ and 90 % power, 54 participants were required per group. Anticipating 15 % attrition, 63 participants were targeted for each arm (total = 126).

2.3.3 Flow of participants

Of 148 patients assessed for eligibility, 18 declined to participate or met exclusion criteria. One hundred twenty-six were randomised; two (1.6 %) withdrew consent before surgery, leaving 124 analysed per intention-to-treat (Figure 1).

2.4 Data-collection tools

Variable	Instrument	Scale / unit	Validity / reliability
Pain on injection	100-mm VAS (anchored “no pain” to “worst imaginable pain”)	mm	Validated for acute procedural pain, test–retest r > 0.90 [20]
Anaesthesia onset	Digital stopwatch	seconds	Inter-observer ICC = 0.99
Anaesthesia duration	Pin-prick test with 30G needle every 5 min post-suturing	minutes	Standard clinical method [21]
Intra-operative blood loss	Weighed gauze method	mL	Accuracy ± 2 mL
Ecchymosis / oedema	Standardised photographs scored by blinded oculoplastic surgeon using four-point Likert scale	0–3	$\kappa = 0.83$

All forms were piloted on ten non-study patients to ensure clarity and timing feasibility.

2.5 Data-collection procedure

1. **Preparation of anaesthetic solutions**
    - **Control**: 2 % lidocaine with epinephrine 1 : 100 000 (AstraZeneca).
    - **Intervention**: Same solution buffered immediately before use with 8.4 % $NaHCO_3$ in a 5 : 1 ratio (creating pH ≈ 7.2). The pharmacy technician, not otherwise involved in surgery or assessment, prepared 10-mL syringes labelled with the randomisation code only.
2. **Surgical protocol** Patients were placed supine; skin antisepsis was achieved with 5 % povidone-iodine. Using a 30-gauge needle, 3–5 mL of assigned anaesthetic was infiltrated subcutaneously along the marked incision line (injection rate ≈ 0.1 mL s^{-1}).
    - **Pain recording:** The patient moved a sliding marker on the VAS immediately after injection of each eyelid; the mean of right and left scores was used.

- **Onset:** Time from initial infiltration to loss of pin-prick sensation along the incision was recorded. Standardised upper-lid skin excision and 6-0 polypropylene skin closure were performed by two consultants following an identical operative checklist.

3. **Post-operative assessment** Duration of anaesthesia was measured until return of pin-prick sensation at three peri-incisional points. Bruising and swelling were scored at 24 h and 7 days. Surgeon satisfaction (5-point Likert) and patient global satisfaction (0–10) were collected at day 7.

2.6 Data management and statistical analysis

Data were entered into REDCap and exported to IBM SPSS Statistics v29. Normality was examined using Kolmogorov–Smirnov tests and Q–Q plots. Continuous variables are reported as mean ± SD (parametric) or median (IQR) (non-parametric); categorical variables as frequencies and percentages.

- **Primary outcome (VAS pain):** Independent-samples t-test.
- **Secondary outcomes:**
  - Onset time, anaesthetic volume, duration — t-test or Mann–Whitney U as appropriate.
  - Ecchymosis / oedema, complication rates — χ^2 or Fisher's exact. Effect sizes (Cohen d or φ) and 95 % CIs accompany all comparisons. Two-sided $p < 0.05$ indicates statistical significance. Missing data (< 2 %) were handled by multiple imputation (five datasets) under a missing-at-random assumption.

2.7 Ethical considerations

The study adhered to the Declaration of Helsinki (2013) and was approved by the King Faisal University Research Ethics Committee. All participants received a detailed information sheet in Arabic and English and provided written informed consent. Confidentiality was maintained through coded identifiers; only the principal investigator held the key. Patients were informed of their right to withdraw at any stage without prejudice to care. No financial incentives were offered. Buffered lidocaine is an accepted practice with minimal risk; nonetheless, an independent data-safety monitor reviewed adverse events quarterly.

3. RESULTS

In total, 126 patients were enrolled and randomised into two groups: the buffered lidocaine group (n=63) and the non-buffered lidocaine group (n=63). Two patients withdrew consent prior to surgery (one from each group), resulting in 124 participants for the final intention-to-treat analysis.

3.1 Baseline Characteristics of Participants

Table 1 presents the baseline demographic and clinical characteristics of participants in both study groups, demonstrating comparable distribution across all measured variables. The mean age and BMI were closely aligned between the buffered and non-buffered lidocaine groups, with no statistically significant differences, indicating homogeneity in general health status. The proportion of female participants was slightly higher than male in both arms, reflecting a similar gender composition. Additionally, the prevalence of comorbid conditions such as hypertension and diabetes mellitus, along with ASA class distribution, showed balanced representation between the two groups. The lack of significant variation (all $p > 0.05$) confirms that randomisation effectively achieved baseline equivalence, ensuring internal validity for subsequent comparisons.

Table 1: Baseline Demographic and Clinical Characteristics (n=124)

Characteristic	Buffered Lidocaine (n=62)	Non-buffered Lidocaine (n=62)	p-value
Age (years), mean (SD)	49.2 (9.3)	50.7 (8.8)	0.317
Sex, female, n (%)	48 (77.4%)	46 (74.2%)	0.687
BMI (kg/m²), mean (SD)	26.3 (3.8)	27.1 (4.2)	0.275
ASA class II, n (%)	10 (16.1%)	12 (19.3%)	0.648
Hypertension, n (%)	9 (14.5%)	11 (17.7%)	0.610
Diabetes Mellitus, n (%)	6 (9.7%)	7 (11.3%)	0.775

3.2 Pain Assessment during Injection

Table 2 presents the comparison of pain intensity during local anaesthetic injection between the buffered and non-buffered lidocaine groups. The mean VAS score in the buffered group was 21.7 mm (SD 12.4), substantially lower than the 38.4 mm (SD 15.8) observed in the non-buffered group. The mean difference of -16.7 mm, with a 95% confidence interval ranging from -21.9 to -11.4, reflects a statistically significant reduction in perceived pain ($p < 0.001$). This marked difference highlights the impact of buffering on injection comfort across the study cohort.

Table 2: Comparison of Pain Scores during Injection

Parameter	Buffered Lidocaine (n=62)	Non-buffered Lidocaine (n=62)	Mean Difference (95% CI)	p-value
VAS score, mean (SD)	21.7 (12.4)	38.4 (15.8)	-16.7 (-21.9, -11.4)	<0.001

3.3 Anesthesia Characteristics

Table 3 presents a comparative analysis of anaesthetic performance indicators between buffered and non-buffered lidocaine groups. The onset of anaesthesia was notably faster in the buffered group, with a mean initiation time of 68.7 seconds compared to 94.2 seconds in the non-buffered group, reflecting a statistically significant difference ($p < 0.001$). Additionally, the duration of anaesthesia was longer in the buffered group, averaging 112.3 minutes versus 103.8 minutes ($p = 0.002$), indicating a more sustained analgesic effect. Importantly, patients in the buffered group required a lower mean volume of anaesthetic (3.8 mL) compared to those receiving the non-buffered formulation (4.4 mL), also with a highly significant p-value ($p < 0.001$). These findings collectively highlight measurable enhancements in anaesthetic efficiency associated with buffering.

Table 3: Anesthesia Onset, Duration, and Volume Used

Parameter	Buffered Lidocaine (n=62)	Non-buffered Lidocaine (n=62)	p-value
Onset (seconds), mean (SD)	68.7 (16.3)	94.2 (18.6)	<0.001
Duration (minutes), mean (SD)	112.3 (13.7)	103.8 (15.2)	0.002
Volume used (mL), mean (SD)	3.8 (0.7)	4.4 (0.9)	<0.001

3.4 Intra-operative Bleeding

Table 4 presents a comparative analysis of intra-operative blood loss between patients who received buffered versus non-buffered lidocaine. The mean blood loss was slightly lower in the buffered lidocaine group (6.3 mL) compared to the non-buffered group (6.7 mL); however, the difference of 0.4 mL did not reach statistical significance ($p = 0.136$). The 95% confidence interval (-0.9 to 0.1) includes zero, further indicating the absence of a clinically meaningful difference between the two groups. The variability, as reflected by the standard deviations, was relatively small and consistent across both groups, suggesting homogeneity in surgical technique and patient-related factors.

Table 4: Intra-operative Blood Loss Comparison

Parameter	Buffered Lidocaine (n=62)	Non-buffered Lidocaine (n=62)	Mean Difference (95% CI)	p-value
Blood loss (mL), mean (SD)	6.3 (1.4)	6.7 (1.6)	-0.4 (-0.9, 0.1)	0.136

3.5 Postoperative Complications (Bruising and Swelling)

Table 5 presents the comparative assessment of postoperative ecchymosis and edema between the buffered and non-buffered lidocaine groups at two time points—24 hours and 7 days post-surgery. While the buffered group consistently showed slightly lower mean scores for both ecchymosis and edema at each interval, these differences did not reach statistical significance. The values suggest a modest trend toward reduced tissue reaction in the buffered group, particularly at the 24-hour mark for ecchymosis (mean 1.6 vs. 1.8; $p = 0.081$), but overall the findings indicate that the type of lidocaine formulation did not markedly influence the resolution of postoperative bruising or swelling within the first postoperative week.

Table 5: Postoperative Ecchymosis and Edema Scores

Outcome	Buffered Lidocaine (n=62)	Non-buffered Lidocaine (n=62)	p-value
Ecchymosis at 24h (score), mean (SD)	1.6 (0.4)	1.8 (0.5)	0.081
Edema at 24h (score), mean (SD)	1.3 (0.4)	1.4 (0.5)	0.236
Ecchymosis at day 7 (score), mean (SD)	0.4 (0.2)	0.5 (0.3)	0.211
Edema at day 7 (score), mean (SD)	0.3 (0.2)	0.4 (0.3)	0.243

3.6 Patient and Surgeon Satisfaction

Table 6 presents the satisfaction ratings from both patients and surgeons following upper-eyelid blepharoplasty using either buffered or non-buffered lidocaine. The results indicate a clear preference for buffered lidocaine, as evidenced by significantly higher mean satisfaction scores in both groups. Patients in the buffered group rated their overall procedural experience at an average of 9.1 out of 10, compared to 8.2 in the non-buffered group. Likewise, surgeons expressed greater satisfaction with the anaesthetic performance, assigning a mean score of 4.7 out of 5 versus 4.1 in the control group. The

statistically significant differences ($p < 0.001$ for both parameters) suggest a consistently more favorable intraoperative and perioperative experience associated with the buffered formulation.

Table 6: Satisfaction Scores

Satisfaction Parameter	Buffered Lidocaine (n=62)	Non-buffered Lidocaine (n=62)	p-value
Patient satisfaction (0–10), mean (SD)	9.1 (0.7)	8.2 (1.1)	<0.001
Surgeon satisfaction (1–5), mean (SD)	4.7 (0.3)	4.1 (0.5)	<0.001

4. DISCUSSION

This randomized controlled trial provides compelling evidence supporting the use of sodium bicarbonate-buffered lidocaine in upper-eyelid blepharoplasty. Buffered lidocaine significantly reduced pain upon injection, accelerated the onset of anaesthesia, decreased the total volume of local anaesthetic required, and improved both patient and surgeon satisfaction. Importantly, these benefits were achieved without compromising hemostasis or increasing postoperative complications such as bruising or oedema.

Pain perception during medical procedures, especially in cosmetic and ophthalmic settings, is a multidimensional experience shaped by physiological, cognitive, and emotional factors. Infiltration pain is frequently identified by patients as the most distressing part of office-based surgery, potentially triggering anxiety and avoidance behaviors [23]. From a psychophysiological perspective, the initial nociceptive stimulus can activate the hypothalamic-pituitary-adrenal (HPA) axis, increase sympathetic tone, and result in anticipatory anxiety, heightened pain sensitivity, and reduced tolerance to subsequent procedures [24]. Therefore, reducing procedural pain not only improves immediate comfort but may also enhance long-term patient attitudes toward surgical care and adherence to postoperative recommendations [25].

Our findings align with existing literature demonstrating that buffering local anaesthetic solutions reduces pain at the time of injection. The analgesic benefit arises primarily from pH modulation; buffered lidocaine has a pH closer to physiological levels (7.2–7.4), increasing the proportion of non-ionised lidocaine molecules that diffuse rapidly across neuronal membranes [26]. Several clinical studies have reported that pH-adjusted lidocaine leads to lower visual analogue scale (VAS) scores in dermatologic, dental, and obstetric procedures [27,28]. In periocular settings, Welch et al. found a significant bilateral reduction in pain scores when buffered lidocaine was used, consistent with the findings of the present study [9].

The observed reduction in anaesthetic onset time among patients receiving buffered lidocaine is clinically relevant. A more rapid block allows for shorter procedural preparation times and reduces patient apprehension associated with delays in anaesthetic efficacy. Metzinger et al. previously noted that buffered lidocaine resulted in faster anaesthesia without compromising vasoconstriction in eyelid surgeries [29]. Our data confirm these pharmacodynamic advantages in a larger cohort and under double-blinded conditions, thereby strengthening the external validity of earlier results.

An important psychological implication of our study lies in the relationship between procedural pain and perceived satisfaction. Patients exposed to buffered lidocaine reported higher satisfaction scores, likely due to reduced injection discomfort and quicker procedural flow. Psychological theories of procedural memory indicate that initial and final impressions carry disproportionate weight in forming global evaluations—known as the “peak-end rule” [30,31]. Minimising discomfort at the beginning of the procedure (i.e., during injection) may thus improve retrospective evaluations of the entire surgical experience. Furthermore, satisfaction is not merely a subjective endpoint but correlates strongly with health-related quality of life, willingness to recommend care, and adherence to post-operative guidance [32].

From the surgical perspective, buffered lidocaine also enhanced the operative experience, as reflected in higher surgeon satisfaction scores. Reduced anaesthetic volume and more consistent anaesthetic spread facilitated cleaner dissection planes and minimised tissue distortion, which is particularly important in aesthetic procedures [33]. Previous studies have suggested that large volumes of non-buffered lidocaine may transiently distort the surgical field, complicating tissue handling and increasing the risk of asymmetry or contour irregularities [34].

Contrary to concerns that buffering may impair the stability of epinephrine and lead to increased intra-operative bleeding, our findings demonstrated no significant difference in blood loss between groups. This supports earlier chemical analyses which found that adrenaline remains stable in buffered solutions for up to 24 hours when freshly prepared [35]. Moreover, postoperative complications such as oedema and ecchymosis did not differ between groups, reaffirming the safety profile of buffered lidocaine in oculoplastic contexts [36].

Nevertheless, our findings should be interpreted in light of some limitations. While the sample size was adequately powered

for primary outcomes, subgroup analyses (e.g., based on age or anxiety levels) were not conducted. Psychological variables such as baseline pain sensitivity, trait anxiety, or past surgical trauma, which can modulate pain perception, were not formally assessed [37]. Future studies incorporating psychometric tools could help elucidate the interaction between patient characteristics and the observed benefits of buffered anaesthesia. Additionally, while this study focused on blepharoplasty, generalisation to other facial or ophthalmic procedures should be made cautiously and ideally be supported by procedure-specific trials [38,39,48–56,40–47].

Despite these limitations, the present study has notable strengths: a rigorous double-blind design, standardised surgical and anaesthetic protocols, use of validated outcome measures, and inclusion of both clinical and patient-reported endpoints. These elements enhance the methodological integrity and practical applicability of our findings. Given the minimal cost and ease of implementation, buffering lidocaine with sodium bicarbonate appears to be a simple, safe, and effective intervention that enhances the perioperative experience for both patients and clinicians.

In conclusion, this study adds to the growing body of evidence suggesting that buffered lidocaine significantly improves comfort, efficiency, and satisfaction in upper-eyelid blepharoplasty. The integration of psychological principles in the assessment of pain and satisfaction further underscores the importance of patient-centred perioperative care. Future studies should explore the broader applicability of this intervention across other surgical domains and incorporate psychosocial measures to deepen understanding of individual variability in response to buffered anaesthesia.

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