Original Article/*Özgün Araştırma*

doi: 10.54875/jarss.2022.12599

Efficacy of Sodium Bicarbonate Addition into Local Anesthetic Infiltration for Postoperative Pain Levels After Rhinoplasty

Rinoplasti Ameliyatlarında Lokal Anestezik İnflitrasyonuna Bikarbonat Eklenmesinin Postoperatif Ağrı Düzeylerine Etkisi

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ABSTRACT

Objective: Postoperative pain intensity is one of the decisive factors in patient satisfaction following surgery. Therefore, we aimed to investigate the efficacy of sodium bicarbonate addition to local anesthetic infiltration over pain levels after rhinoplasty operations which were performed under general anesthesia.

Methods: Following ethics committee approval, medical records of patients who underwent rhinoplasty surgery were retrospectively reviewed to evaluate postoperative pain levels. Forty concomitant patients who received standard local anesthetic infiltration without bicarbonate were randomised as Control group (Group 1). The patients in whom bicarbonate was added to local anesthetic solution were selected as interventional group (Group 2). Initial pain time and pain levels at the 1st, 2nd and 6th hours were obtained from anesthesia, recovery unit and ward follow-up forms. Pain levels were evaluated with Visual Analog Scale (VAS) of 0 to 10.

Results: This retrospective study included 80 (64 female and 16 male) endonasal rhinoplasty patients. There was no statistically significant difference found in the postoperative first analgesic requirement time. However, VAS at the postoperative 1st, 2nd and 6th hours of Group 2 were significantly lower than Group 1 ($p<0.05$).

Conclusion: Although it does not delay the beginning of postoperative pain, buffering the local anesthetic infiltration with addition of sodium bicarbonate significantly decreases pain levels at the postoperative period. It is a safe and an inexpensive method, which can efficiently increase patient satisfaction. Thus we recommend more widespread use.

Keywords: Lidocaine, postoperative pain, rhinoplasty, sodium bicarbonate

ÖZ

Amaç: Postoperatif ağrı, ameliyat sonrası hasta memnuniyetinde belirleyici faktörlerden biridir. Bu nedenle genel anestezi altında yapılan rinoplasti ameliyatlarında lokal anestezik infiltrasyonuna bikarbonat eklenmesinin postoperatif ağrı düzeyleri üzerindeki etkinliğini araştırmayı amaçladık.

Yöntem: Etik kurul onayı alındıktan sonra, rinoplasti ameliyatı geçiren hastaların tıbbi kayıtları postoperatif ağrı düzeylerini değerlendirmek için retrospektif olarak incelendi. Sodyum bikarbonatsız standart lokal anestezik infiltrasyonu uygulanan eş zamanlı 40 hasta kontrol grubu (Grup 1) olarak randomize edildi. Lokal anestezik solüsyona sodyum bikarbonat eklenen hastalar girişimsel grup olarak seçildi (40 hasta, Grup 2). Postoperatif ilk ağrı zamanı ve 1., 2. ve 6. saatlerdeki ağrı düzeyleri, anestezi, derlenme ünitesi ve servis takip formlarından elde edildi. Ağrı seviyeleri, 0'dan 10'a kadar Görsel Analog Skala (VAS) ile değerlendirildi.

Bulgular: Bu retrospektif çalışmaya 80 (64 kadın ve 16 erkek) endonazal rinoplasti hastası dahil edildi. Postoperatif ilk analjezik gereksinim zamanı açısından gruplar arasında istatistiksel olarak anlamlı bir fark bulunmadı. Ancak Grup 2'de postoperatif 1., 2. ve 6. saatlerde VAS, Grup 1'e göre anlamlı derecede düşüktü ($p<0.05$).

Sonuç: Postoperatif ağrının başlamasını geciktirmese de lokal anestezik infiltrasyonunun sodyum bikarbonat ilavesi ile tamponlanması postoperatif dönemde ağrı düzeylerini önemli ölçüde azaltır. Hasta memnuniyetini etkin bir şekilde artırabilen güvenli ve ucuz bir yöntemdir. Bu nedenle daha yaygın kullanılmasını öneriyoruz.

Anahtar sözcükler: Lidokain, postoperatif ağrı, rinoplasti, sodyum bikarbonat

Received/Geliş tarihi : 02.08.2022
Accepted/Kabul tarihi : 20.09.2022
Publication date : 24.10.2022

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Cite as: Camgoz Eryilmaz N, Eryilmaz AT. Efficacy of sodium bicarbonate addition into local anesthetic infiltration for postoperative pain levels after rhinoplasty. JARSS 2022;30(4):240-244.

INTRODUCTION

Most local anesthetics are commercially prepared at an acidic pH to enhance shelf life. Protons from the acidic solution may activate acid-sensing ion-channel receptors and cause pain (1). Addition of bicarbonate may theoretically decrease activation of these nociceptors. Local anesthetics work by diffusing through the perineural sheath and binding to sodium channels. Only non-ionised fraction of the local anesthetics is able to cross the nerve membrane. The addition of sodium bicarbonate to local anesthetics increases the non-ionised fraction and potentiates their impulse-blocking action on peripheral nerves (2-4).

There are numerous clinical trials which were performed under local anesthesia investigated the pain reduction in local anesthetic administration through pH buffering by adding sodium bicarbonate to local anesthetic solutions (2-7). Therefore, we aimed to investigate the efficacy of sodium bicarbonate addition to local anesthetic infiltration on the postoperative pain relief in patients scheduled for rhinoplasty under general anesthesia.

MATERIALS AND METHODS

Following local ethics committee approval (No: E-77082166-604.01.02-411659, Date: 20.07.2022), the medical records of patients aged between 18-62 years who underwent surgery for rhinoplasty in Gazi University Medical School Hospital in Plastic and Reconstructive Surgery operating rooms between 2007-2008 were retrospectively reviewed. Endonasal rhinoplasty patients that were operated by the same surgeon without septal and conchal intervention were determined. The review revealed that sodium bicarbonate was added to local anesthesia infiltration (8 mL 2% lidocaine with ephineprine + 2 mL sodium bicarbonate) to the nose in the beginning of rhinoplasty surgery in 40 patients. For the statistical analysis 40 concomitant patients who received standard local anesthetic infiltration (8 mL 2% lidocaine with ephinephrine+2 mL 0.9% saline) without bicarbonate were randomised as Control group (Group 1). The group in which bicarbonate was added to the local anesthetic solution was evaluated as interventional group (Group 2) (Table I). These patients were evaluated as interventional group (Group 2). Total intravenous anesthesia (propofol, remifentanil) and standard postoperative analgesia (tramadol 100 mg and 1 g paracetamol intravenously) methods were documented in all patients. Pain levels at the 1st, 2nd and 6th hours and first analgesic requirement time were obtained from anesthesia, recovery unit and ward follow-up forms. Pain levels were evaluated with Visual Analog Scale (VAS) of 0 through 10 (Zero corresponding to no complaint at the moment while 10 to be the worst possible pain ever felt).

Statistical Analysis

When the VAS scores were evaluated, it was estimated that there would be a difference of 2 values between the two groups and the standard deviation would be 3. The power of the study was found to be 84.6% with an alpha value of 0.05 and a confidence interval of 95% with 40 patients in both groups. Data were analysed using the IBM SPSS 20.0 statistical program and presented as mean ± standard deviation (Mean ± SD.), minimum, maximum, n, and percent (%) where appropriate and $p<0.05$ was considered as statistically significant. Following descriptive statistics, Kolmogorov-Smirnov test was used to determine whether there was a normal distribution. Normally distributed data were presented as mean ± standard deviation, others were expressed as median (25%-75%). Student's t tests were performed in independent groups.

RESULTS

Sixty four out (80%) of 80 patients were female and the remaining 16 (20%) were male. No difference was observed in demographic data and duration of operation between the groups as presented in Table II.

Postoperative first analgesic requirement times were 39 ± 24 (5-90) minutes in Group 1 and 45 ± 30 (5-110) minutes in Group 2. However, VAS in Group 2 at the postoperative 1st, 2nd and 6th hours were significantly lower than that of Group 1 ($p<0.05$) (Table III). There were no documented complications due to local anesthetic infiltration in both groups.

Table I. Study Groups

Group	n	Local Anesthetic Solution
1	40	8 mL of 2% lidocaine - epinephrine solution with 2 mL of 0.9% saline
2	40	8 mL of 2% lidocaine - epinephrine solution with 2 mL of sodium bicarbonate

Table II. Demographic Data of Patients [n, Mean (Minimum-Maximum)] and Duration of Operation [(Mean ± SD (Minimum-Maximum)]

	Group 1 (n=40)	Group 2 (n=40)
Age (years)	30 (18-53)	31 (19-62)
Gender (F/M) (n)	30/10	34/6
ASA (I/II) (n)	31/9	29/11
Duration of operation (minutes)	36 ± 13 (20-90)	31 ± 10 (30-90)

No statistically significant difference was found between groups ($p>0.05$). **n:** Number, **SD:** Standard Deviation, **F:** Female **M:** Male, **ASA:** American Society of Anesthesiologists.

Table III. Comparison of the Groups According to Pain Levels (VAS Score)

Evaluation Period	Group	Mean	SD	Minimum	Maximum	p*
Postoperative 1st hour	1	6.12	2.88	1	10	0.031
	2	3.82	2.94	1	10	
Postoperative 2nd hour	1	6.03	2.79	1	10	0.037
	2	4.01	2.82	1	8	
Postoperative 6th hour	1	5.98	2.91	1	9	0.029
	2	3.51	2.87	1	8	

***(p<0.05)., **VAS:** Visual Analog Scale, **SD:** Standard deviation.

DISCUSSION

Postoperative pain intensity is one of the decisive factors in patient satisfaction following surgery. According to the findings in current study, buffering the local anesthetic solution with addition of sodium bicarbonate significantly decreases postoperative pain. Effective relief of postoperative pain allows a faster postoperative recovery period and associated with lower morbidity, and higher patient satisfaction (8-11).

Local anesthetics act by diffusing through the perineural sheath and attaching to sodium channels (2-4, 12). Only the non-ionised fraction of the local anesthetic is able to cross the nerve membrane. Local anesthetics are commercially prepared at a pH of 6 for maximum solubility and stability to increase shelf life, and at this pH only 1% of the drug is non-ionised (13). By neutralizing the solution with sodium bicarbonate to a pH of 7, the non-ionised fraction increases to 11%. Increasing of pH reduces the tissue irritation and also the onset of the analgesia can be more rapid. Nociceptors may be less sensitive to the non-ionised form, thereby reducing the pain of infiltration (14).

Precipitation may be a problem in buffered local anesthetic solutions. A 10:1 ratio is recommended for lidocaine buffering, due to concern about precipitation of the solution. But up to 3:1 ratio, no precipitation was observed in several studies (15-17). The ratio used in this study was 4:1, and no problem was observed due to buffered local anesthetic solution.

Tissue injury produces both peripheral and central nervous sensitization. Peripheral sensitization is a result of the local release of excitatory neurotransmitters and inflammatory mediators. Further physical stimulation of the injured area causes an exaggerated response. Central sensitization occurs as a result of the continuous stimulus from the site of the injury and activation of excitatory receptors in the spinal cord. Central hypersensitivity is responsible for the duration of hypersensitivity within the site of the injury (18). It is generally accepted that, once established, central sensitization may decrease the effectiveness of pain relief targeting the injury zone (18-21). Preemptive analgesia is an analgesic regimen which is initiated before the onset of tissue trauma. Although controversial, preemptive analgesia may reduce the pain levels experienced postoperatively by preventing the central sensitization (22, 23).

Since, postoperative 6th hour is normally beyond the duration of the lidocaine effect, there is significant decrease of the pain levels in the buffered local anesthetic group in this study. This may be due to preemptive analgesia effect of the buffered local anesthetic infiltration. Protection of sensory neurons against central sensitization may offer relief from pain occurring after surgery. Thus, alkalinization of local anesthetic solution may contribute to preemptive analgesia, by enhancing the quality of the block (24).

There are several factors effecting patient satisfaction in the postoperative period, such as pain, nausea and vomiting, and hemorrhage (25). Postoperative pain intensity is an important factor in patient satisfaction in several studies. Effective relief of postoperative pain allows a faster postoperative recovery period and is associated with lower morbidity and higher patient satisfaction. Patients with lower postoperative pain scores were the ones who reported higher satisfaction levels (8-11, 25-29). Improving postoperative pain control is one of the major issues that should be seriously considered in the field of surgery.

Patient satisfaction is also an extremely important factor that affects the overall success for plastic surgeons. Rhinoplasty is one of the most common performed aesthetic surgery procedures. It can be performed as day surgery or one night stay surgery, and can be performed under general anesthesia, sedation or local anesthesia. Effective relief of pain during surgery and postoperative period is an important concern in all. Therefore, regardless of the anesthetic choice, preemptive infiltration of lidocaine and adrenaline to reduce bleeding and control postoperative pain is a routine procedure for almost all rhinoplasty surgeries. Our study showed that buffering local anesthetic solutions with sodium bicarbonate is beneficial in enhancing patient satisfaction by lowering postoperative pain levels, in addition to the normal administration of local anesthetic with adrenaline.

CONCLUSION

Buffering the local anesthetic infiltration with addition of sodium bicarbonate significantly decreases pain levels in the postoperative period. It does not delay the first analgesic requirement which is a safe and an inexpensive method that provided high patient satisfaction in the postoperative period. Thus, we recommend the more widespread use of buffering local anesthetic solutions.

DISCLOSURE

None of the authors has any disclosures of commercial associations or financial relationships.

AUTHOR CONTRIBUTIONS

Conception or design of the work: NCE

Data collection: NCE, ATE

Data analysis and interpretation: NCE, ATE

Drafting the article: NCE, ATE

Critical revision of the article: NCE, ATE

All authors (NCE, ATE) reviewed the results and approved the final version of the manuscript.

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