



ARAŞTIRMA / RESEARCH

Effect of warming of local anesthesia on pain and anesthesia duration before wisdom tooth extraction

Yirmi yaş dişi çekimi öncesinde ısıtılmış lokal anestezi solüsyonunun ağrı ve anestezi süresine etkisi

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Abstract

Purpose: Local anesthetic agents have been widely used in dentistry for several decades. Administration of local anesthetics at body temperature has been reported to shorten the onset time and reduce pain during injection. The aim of this study was to compare the effect of the local anesthetic at body temperature and room temperature before wisdom tooth extraction in terms of injection pain and onset of anesthesia.

Materials and Methods: Forty-six adult patients, who were undergoing wisdom tooth extraction, participated in this split-mouth study. To the one side of the patient's jaws warmed anesthetic solution and to the other side anesthetic solution at room temperature was injected.

Results: There was no statistically significant difference between two groups. Mean onset time of anesthesia and VAS scores during injection were similar for room temperature and warmed anesthetic solution groups. None of the patients exhibited any complications during and after injection.

Conclusion: Further studies, which include large number of samples, may indicate the effectiveness of warmed anesthetic especially with regard to reducing pain during injection.

Keywords: Anesthesia, dental fear, wisdom teeth, pain

Öz

Amaç: Lokal anestezi ajanlar uzun yıllardır diş hekimliğinde yaygın olarak kullanılmaktadır. Vücut sıcaklığında uygulanan lokal anesteziklerin anestezi süresini kısalttığı ve enjeksiyon sırasında duyulan ağrıyı azalttığı rapor edilmiştir. Bu çalışmanın amacı yirmi yaş dişi çekimi öncesi uygulanan vücut sıcaklığında ve oda sıcaklığında lokal anesteziklerin ağrı ve anestezi süresi açısından etkilerinin karşılaştırılmasıdır.

Gereç ve Yönetim: Yirmi yaş dişi çekimi yapılacak 46 yetişkin hasta bu split-mouth çalışmaya dahil edildi. Hastaların çenelerinin bir tarafına ısıtılmış lokal anestezi enjekte edilirken diğer tarafına oda sıcaklığında lokal anestezi enjekte edildi.

Bulgular: İki grup arasında istatistiksel olarak anlamlı fark bulunamadı. Ortalama anestezi süresi ve enjeksiyon sırasında elde edilen VAS değerleri her iki grupta da benzerdi. Enjeksiyon sırasında ve sonrasında hastalarda herhangi bir komplikasyon gözlenmedi.

Sonuç: Daha fazla örnek içeren ileriki çalışmalar, özellikle enjeksiyon sırasında ağrıyı azaltma ile ilgili ısıtılmış anestezinin etkinliğini gösterebilir.

Anahtar kelimeler: Anestezi, dental korku, yirmi yaş dişi, ağrı

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INTRODUCTION

Local anesthetic agent application is an indispensable procedure in modern dentistry and medicine. At the same time local anesthetic injection is one of the most fearful and anxious procedure in medical and dental practice for both children and adults¹⁻⁶. Local anesthetics can cause burning or stinging sensation during injection, and this sensation has been reported to keep people away from dental procedures. Various techniques have been defined to reduce pain during injection such as; topical anesthesia, slow injection, smaller gauged needles, pressure anesthesia, avoiding use of epinephrine, buffering anesthesia and warming local anesthetic solution prior to use³.

Although warming of local anesthetic solution had been advocated by many authors to reduce pain during injection, some contrary reports with no benefits in reducing pain and accelerating onset of anesthesia^{3,7} were published. In the medical literature, there are many studies investigating effectiveness of warming local anesthesia concerning ophthalmic, plastic and general surgery^{3-6,7}. In contrast to medical literature, dental literature consists of fewer studies about possible benefits of warming local anesthesia. Local anesthetics with lidocaine, bupivacaine and procaine were reported to be warmed with thermostatically controlled water baths, incubators, fluid warmers, warming tray, and syringe warmer³. The aim of this study was to compare the effects of local anesthesia in body temperature with local anesthesia in room temperature in terms of injection pain and onset of anesthesia.

MATERIALS AND METHODS

This prospective, randomized, single-blinded, controlled clinical trial was approved by Clinical Research Ethics Committee of Erciyes University Faculty of Medicine (Document Number: 2012/396, Date: 05.06.2012). Informed consent was obtained from each patient.

Fifty patients who need bilateral wisdom teeth extraction at lower jaw were evaluated for this study. Two patients were excluded from the study because of overreaction due to dental fear during injection. A total of 46 volunteer adult patients who underwent bilateral mandibular wisdom teeth extraction in Erciyes University & Izmir Katip Celebi University Faculty of Dentistry, Oral and Maxillofacial Surgery

Departments were included to this study. The exclusion criteria were; having progressive systemic disorders such as diabetes, hypertension etc., known allergy to any of local anesthetic agents, use of neurological drugs, pregnancy and mental retardation. Also, patients who have dental fear and injection phobia, excluded from the study.



Figure 1. Before injection the anesthetic ampoule was located in the hole of CALSET composite heater (AdDent Inc. USA).

The study was designed to compare warmed anesthetic solution (WA) with anesthetic solution in room temperature (RT) for a sample of 46 patients requiring buccal infiltration anesthesia for bilateral extraction of mandibular wisdom teeth. Both teeth were extracted in the same surgery and the study was performed in a 'split-mouth design', where one side was assigned for WA solution (test group) and the opposite side for RT anesthetic solution (control group). Coin tossing randomization method performed for each trial participant.

Anesthetic solution in RT (22°C) was injected to the one side of these patients and to the other side anesthetic solution in body temperature (37°C) was injected. Mean injection time was 10 seconds and mean injection volume was 0,5cc. After the injection, onset of anesthesia was evaluated by needle tactile every 3 seconds and the time was recorded when patient didn't feel pain. Articaine hydrochloride (40 mg/ml) with epinephrine HCl (0.006 mg/ml) (Ultracain DS- Sanofi-Aventis) was used in all injections with 27G-0,4X50mm needles. No topical anesthetics were given in order to avoid its possible interference with the subjects' pain perception. Before injection of warmed local anesthesia, the

anesthetic ampoule was located in the hole of CALSET composite heater (AdDent Inc. USA) (figure 1). All injections were performed by the same calibrated surgeon. A visual analog scale (VAS) of 0 to 100 mm, which was designed as 0 being no pain and 100 being the worst pain ever experienced, was given to the patients to quantify subjective pain during injection process.

Statistical analysis

Data were analysed using IBM SPSS Statistics for Windows version 25.0 (Armonk, NY: IBM Corp). Shapiro Wilk normality test was used to evaluate the distribution of data. Data was not distribute normally. There fore Mann-Whitney *U* test was used for intergroup analysis. $p < 0.05$ was considered to indicate statistically significance.

RESULTS

The study was completed with a total of 46 subjects (29 female, 17 male) median age was 22 years (Interquartile range (IQR) 20, 26 years). Mean onset time of anesthesia and VAS scores during injection were similar for RT and WA groups. There was no statistically significant difference between two groups. All data were presented in Table 1. None of the patients exhibited complication during and after injection.

Table 1. Onset time and pain evaluation

Clinical Variable Mean (SD)	Room Temperature (n=46)	Warmed (n=46)	p
VAS	24.44(21.98)	16.66(16.41)	0.065
Onset (sec.)	16.11 (19.18)	10.00 (9.48)	0.079

VAS: Visual analogue scale, Onset: mean onset time of anesthesia

DISCUSSION

The warming of local anesthetics up to body temperature is believed to decrease the amount of pain experienced during injection and several reports advocated this application ^{6,8,9}. Fu-Chao stated that if a local anesthetic solution was injected at a temperature of 36°C accelerates the onset of sensory block compared to non-warmed anesthetic in epidural anesthesia¹⁰. However, in the literature there is not enough study concerning the effectiveness of warmed anesthetic solution in oral region. In the

present study, the CALSET composite heater was used to warm the local anesthetic agent and injected by infiltration technique into oral mucosa without any complication during injection or any adverse effect within 24 hours following period. The temperature of anesthetic solution during injection into the tissue was considered to differ from body temperature because of heat loss during the elapsed time between aspiration of solution into injectors and injection into tissue. Thus, the anesthetic solutions were taken from chamber when the temperature of CALSET device chamber was 38°C.

The administration of local anesthetics is one of the most common procedures in dentistry ¹¹. Since Boggia¹² first described warming of local anesthesia as a pain-reducing measure, the mechanism of action is still unknown. Davidson and Boom⁸ mentioned that colder solutions stimulate nociceptors more than warmer solutions. Similarly, Bainbridge ⁹ suggested that nerve endings are more sensitive to cold than to warm thus there may be less stimulation by warmed solutions. Another explanation is that local anesthetics with a pKa (dissociation constant) value are also temperature dependent and the more local anesthetic is warmed, the more pKa value is decreased ¹³. This form of the local anesthetic produces rapid anesthesia and also helps to reduce pain during injection. According to Powell¹⁴ pKa of lidocaine is 7.57 at 40°C and 7.92 at 25°C. Thus, warming of lidocaine may increase the speed of onset and the quality of local anesthesia. Because no information about pKa value of articaine is reported further studies about the exact role of pKa would help us in understanding the mechanism of action of warming local anesthetics.

Thermal pain threshold was reported above 42.1°C and below 27.6°C in cutaneous sensation¹⁵. Based on these findings, Yang et al¹⁶ reported that temperatures in this range are less likely to induce pain. Although we have no knowledge about thermal pain threshold of intraoral tissues, this may explain reduced feel of pain during injection of warmed anesthetic solution.

Rogers et al¹⁷ investigated possible effect of warming local anesthetic solution prior to dental procedures and found that warming anesthesia before injection was significantly more comfortable than anesthesia at the room temperature. Conversely, before 1990s, several authors reported no significant difference between injection comforts of local anesthetics at room and body temperature^{2, 18}. In 2002, Ram et al¹

applied heated (37°C) and non-heated (21°C) local anesthetic solution (2 % lidocaine with 1:100000 epinephrine) to children bilaterally after using a topical anesthetic. They used Wong-Baker FACES pain rating scale (FPS) and VAS to determine the pain perception and found no significant difference between groups that was consistent with our results.

Patients were unaware of anesthetic solutions which were injected in room temperature or body temperature during procedure so we wanted to avoid bias when receive results from patients.

In English medical literature, there are many studies about warmed local anesthetic application. In 1988, Crag et al¹⁹ compared heated (43°C) and non-heated lidocaine for intra-dermal injection on 25 healthy volunteers. They found that warmed lidocaine produces less burning or pain sensation while intradermal injection. Kaplan and Moy⁵, applied heated (40°C) and non-heated lidocaine to 16 volunteers who underwent tumescent liposuction surgery to symmetric body areas (hips, thighs, arms) bilaterally. The authors used VAS to determine the pain perception and found that mean pain score was significantly reduced in heated anesthetic group. However, in 2008, Allen et al⁶ investigated the effect of heated (37°C) and non-heated lidocaine on 140 patients who underwent cataract surgery under sub-Tenon's anesthesia. They used 4 ml of 2 % lidocaine and 1 ml 0.5 % bupivacaine at room temperature in one group and same anesthetic mixture at body temperature (37°C) in another group. According the results of their double-blind prospective study, there was no significant difference between two groups. The authors concluded that pain felt by patients during injection might be due to an increase in pressure within the sub-Tenon's space rather than direct nociceptor stimulation. In 2007 Sultan⁷ performed a review with regard to warming local anesthetics and suggested that warming local anesthesia significantly reduces pain while injection. In 2011 Hogan et al³ analyzed 449 studies and performed a meta-analysis with 18 papers. Only 1 study of all included studies in that review was concerning dentistry and performed on children only¹. They concluded that pain sensation reduces during performing heated local anesthetics injected subcutaneously or intradermally while no significant benefit was observed for intraoral injection. However, they mentioned that only a single study of intraoral injection on children was included. In another survey in the United Kingdom, it was found

that 34 % of maxillofacial surgeons and 8 % of general surgeons regularly used warmed local anesthetics to reduce pain²⁰. The results of the survey indicated the point that many maxillofacial surgeons routinely used the warmed local anesthesia without sufficient evidence based studies about the benefits of warmed local anesthetics in dental literature. This means that maxillofacial surgeons who use warmed local anesthesia in practice seem to have seen the benefits of warmed anesthesia before the injection.

Almost all studies about efficiency of warmed anesthetic solution which used to numb dermal tissue indicate that warming anesthetic up to body temperature accelerate the onset of sensory block and reduce pain during injection. In 2002, Ram and et al.¹ reported that pain during injection into oral mucosa on children with warmed local anesthetic solution did not differ from non-warmed local anesthetic solution. Also, the test subjects of this study being children and the high possibility of fear from dental procedures of children may affect the results. Although all patients in our study were adult and they did not have dental fear, the results of our study were similar with study in 2002. The anesthetic solution in dentistry generally is injected between oral mucosa and periosteum during infiltrative anesthesia and patients feel pain because of this condition. Also, the anesthetic solution spreads wide tissue space during skin anesthesia. Despite warmed anesthesia injections provides patients themselves more comfortable in oral injections, patients feel pain because of separation during injection between oral mucosa and periosteum. We observed clinically that the patient applied warmed local anesthetic solution felt themselves more comfortable during injection but we did not show any difference statistically. Split mouth design may have caused interference between the pain perception of the patients during first and second buccal anesthesia. Although the ampoules in the CALSET device were heated to 38 °C, anesthetic solutions may have lost their temperature until injected into the tissue. Furthermore, evaluation of onset of anesthesia with needle tactile every 3 seconds may be misleading in determining the real anesthesia time. These reasons may have affected the data obtained in this study.

There is not enough study about the effect of warmed anesthetic solution in dental practice. In this study, we have compared warmed anesthetic solution and anesthetic solution in room temperature in terms of pain and the time of onset of anesthesia. According

to results we couldn't find any significant difference between two groups. However, we have experienced that patients felt more comfortable during warmed anesthetic injection although it wasn't statistically significant. Future studies, which include a large number of samples, may indicate the effectiveness of warmed anesthetic especially with regard to reducing pain during injection.

Yazar Katkıları: Çalışma konsepti/Tasarımı: MU, OAE; Veri toplama: MU, FGYÇ; Veri analizi ve yorumlama: MU, AED; Yazı taslağı: MU, AED, HA; İçerğin eleştirilme: MU, AED, HA; Son onay ve sorumluluk: MU, OAE, AED, FGYÇ,HA; Teknik ve malzeme desteği: -; Süpervizyon: MU, OAE; Fon sağlama (mevcut ise): yok.

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