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Efficacy of Topical and Submucosal Local Anesthesia in Reducing Pain and Anxiety during Inferior Alveolar Nerve Block

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ABSTRACT

Objective: To compare the efficacy of topical and submucosal local anesthesia in reducing pain and anxiety during inferior alveolar nerve block (IANB). **Study Design:** Quasi-experimental study. **Settings:** Institute of Dentistry, CMH Lahore Medical College, Lahore Pakistan. **Duration:** From December 2021 to January 2023. **Methods:** Patients were divided into three groups. In group 1, conventional IANB was given, in group 2, submucosal anesthesia was given before IANB; and in group 3, topical anesthesia was given before IANB. An interview-administered questionnaire was used to mark their level of anxiety and pain. Mann-Whitney U and Kruskal Wallis were used to compare the mean VAS and MDAS scores. **Results:** The mean VAS score was 3.95 ± 1.74. Younger age, females, and the patients in the simple IANB group reported higher VAS scores. Patients in the simple IANB group had significantly higher VAS scores, followed by the patients who received submucosal and topical anesthesia prior to INAB (p=0.01). The mean MDAS score of the patients was 10.16. Middle-aged adults, females, and the simple IANB group reported higher mean MDAS scores. Males (p<0.001) and those who received topical anesthesia (p=0.019) were less anxious. **Conclusion:** The use of topical or submucosal anesthesia before administering IANB can effectively reduce pain and anxiety. The highest anxiety and pain perception levels were found in the simple INAB group, while the lowest pain as well as anxiety levels were reported in the topical anesthesia group.

Keywords: Dental anxiety, Pain, Inferior alveolar nerve block, Submucosal anesthesia, Topical anesthesia.

INTRODUCTION

There is a profound impact of pain on human psychology. The way the human body responds to pain depends on complex biological mechanisms, including emotions controlled by the sympathetic nervous system, neuroendocrine system, and immune system.[1,2] Pain-induced stress and anxiety negatively affect other biological systems. Similarly, it can also lead to nausea, vomiting and, constipation, raised cortisol and blood glucose levels.[3]

Physical pain is amplified during anxiety as it is considered a notable forecaster of pain before, during, and after the treatment. Needle phobia is also a significant stress factor patients experience even before the start of treatment, and this phenomenon is more highlighted in children.[4]

The inferior alveolar nerve block (IANB) is a frequently utilized local anesthetic technique in dental procedures, specifically for mandibular molars and premolars. Despite its common use, many patients experience pain and anxiety during its administration. The pain may be associated with the needle penetration, the injection, or both.[5,6]

Topical anesthesia reduces pain and discomfort, ultimately leading to reduced anxiety. Dental phobia has reportedly been decreased by topical anesthesia during dental treatments.[7,8] The concentration level of topical anesthesia is usually higher than injectable anesthetics to

achieve more diffusion.[7-9] The submucosal injection has been suggested by Walton, Torabinejad, and Levine to decrease the pain of nerve block injection later. Before administering the nerve block, the anesthetic solution is initially injected beneath the mucosal surface to ensure effective local anesthesia and minimize discomfort during the procedure.[10]

This study aimed to compare the two methods of anesthesia (topical and submucosal) in reducing pain and anxiety during inferior alveolar nerve block.

METHODS

This quasi-experimental, cross-sectional study was conducted with the permission of the IRB (Institutional Review Board) of CMH Lahore Institute of Dentistry and with the approval of the Oral and Maxillofacial Surgery Department (case #. 643/ ERC/CMH/LMC), dated 29-Novemebr-2021.

This study was conducted in the Oral and Maxillofacial Surgery Department (OMFS) of Institute of Dentistry, CMH Lahore Medical College from December 2021 to January 2023. The inclusion criteria were the patients aged 16 and above, who presented to the OMFS department for simple orthodontic and 3rd molar non-surgical extractions in the lower jaw and were in generally good health without significant systemic diseases and no history of allergic reactions to lidocaine, epinephrine, or any components of the anesthetic solutions used in the study. Patients were included only if they were not experiencing pain at the time of presentation and were not using any analgesics or anxiolytics that could alter their pain or anxiety levels. Furthermore, eligible participants were required to be free from any ongoing dental or orofacial infections that could influence the response to anesthesia or cause additional pain. Individuals below sixteen years of age, presented with pain or infection, were currently using analgesics or anxiolytics or suffering from anxiety disorders or schizophrenia, which could affect their ability to accurately report pain and anxiety were excluded from the study. Patients who had undergone recent surgery in the orofacial region within the last six months were also excluded to avoid the influence of recent trauma or surgical interventions on pain and anxiety levels.

This study was conducted using a consecutive sampling technique. A sample size of 150 participants was calculated using 90% power of study and 95% confidence interval and 5% level of significance. Three groups of patients were evaluated: Group 1 (IANB group), Group 2 (submucosal before IANB group), and Group 3 (topical before IANB). Patients were included in the study according to the order of arrival. After consent, patients reported to investigators for history and clinical examination, and those who qualified for the survey were sent to clinics where they received Inferior Alveolar Nerve Block (IANB). When the patients comfortably sat on the dental chair, they were asked to rinse their mouths with 0.2% chlorhexidine for anti-sepsis. In group 1, conventional IANB was given using the Halstead technique. In group 2, submucosal anesthesia was given before giving IANB; in group 3, topical anesthesia was given as an anesthetic before IANB.

A 27-gauge long needle was used to give IANB. After insertion of the needle and negative aspiration, lidocaine 2% with 1:100,000 epinephrine was deposited.

In group 2, the submucosal local anesthesia was administered via an insulin syringe, and 50 units of local anesthesia (LA) were deposited before the administration of IANB following the Halstead technique of IANB after 3 minutes.

In group 3, the target site was dried using gauze. A topical anesthetic agent (lidocaine 2%) was applied at the target site before administration of IANB after a 3-minute wait.

Afterward, pain and anxiety levels were determined using an interview-administered questionnaire. The questionnaire consisted of three parts. The first part included demographics and history. The second part consisted of a Visual Analogue Scale (VAS) for recording pain[11], followed by documentation of anxiety via the Modified Dental Anxiety Scale (MDAS).[12] Visual analog scale scores of less than or equal to 3.4 were classified as mild pain, 3.5 to 7.4 as moderate pain, and 7.5 or more as severe pain. An MDAS score of 5-11 is considered mildly anxious, 12-19 moderately anxious, and a score of 19 and above is considered extremely anxious or phobic.[11,12]

Verbal and written consent was taken from the patients; study objectives were explained, and ambiguities were discussed before administering the questionnaire and the procedure. The responses were immediately organized, checked, and fed into the computer in the form of Excel sheets.

Data was analyzed using IBM Statistical Package for Social Sciences (SPSS version 26, IBM Corporation, USA). Mean and standard deviation were calculated for quantitative variables. Shapiro-Wilk test was used to assess the normality of the data. The data was not normally distributed; therefore, the Mann-Whitney U and Kruskal Wallis H tests were used to compare the mean VAS and MDAS scores. A p-value less than or equal to 0.05 was taken as significant.

RESULTS

One hundred and fifty participants volunteered in the study; half were males (n=76, 50.7%), and the other half were females (n=74, 49.3%). The mean age was 42 ± 15. The group in which topical anesthesia was given prior to IANB showed lower VAS and MDAS scores, followed by the group in which submucosal anesthesia was given prior to IANB and the simple IANB group. The mean VAS score of the sample was 3.95 ± 1.74. The younger age group, females, and those who received simple IANB group reported relatively higher VAS scores. There was a significant difference between the mean VAS scores of participants between different LA groups. Patients in the simple INAB group showed higher VAS scores, followed by the submucosal and topical groups (p=0.01) (Table 1).

Table 1: Comparison of mean VAS scores for different demographic categories and LA groups (n=150)

Demographic Categories		n	%	Mean ± SD	Median (IQR)	Test Statistics	p-value
Age (years)	16-21 years	14	9.3%	4.43 ± 2.20	5.0 (3.0)	0.737	0.692*
	22-40 years	64	42.6%	3.91 ± 1.60	4.0 (2.0)		
	≥41 years	72	48.0%	3.89 ± 1.78	4.0 (2.0)		
Gender	Males	76	50.6%	3.79 ± 1.83	3.0 (2.0)	3154.0	0.190$^{\pi}$
	Females	74	49.3%	4.11 ± 1.65	4.0 (2.0)		
LA Groups	Submucosal before IANB	50	33.3%	4.04 ± 2.33	5.0 (4.0)	9.23	0.01*
	Topical before IANB	54	36.0%	3.48 ± .88	3.0 (1.0)		
	Simple INAB	46	30.6%	4.39 ± 1.68	5.0 (3.0)		

*P-values are calculated using the Mann-Whitney U$^{\pi}$ test and Kruskal Wallis H test**

The mean MDAS score of the patients was 10.16 ± 5.0. Middle-aged adults (22-40 years), females, and the simple INAB group reported higher MDAS scores. Females (p<0.001) and those in the only INAB group (p=0.019) were significantly more anxious (Table 2).

Table 2: Comparison of mean MDAS scores for different demographic categories and LA groups (n=150)

Demographic Categories		n	%	Mean ± SD	Median (IQR)	Test Statistics	P value
Age (years)	16-21 years	14	9.3%	9.49 ± 2.64	11.0 (7.0)	0.047	0.977*
	22-40 years	64	42.6%	10.21 ± 5.77	9.0 (7.0)		
	≥41 years	72	48.0%	10.11 ± 4.64	10.5 (7)		
Gender	Males	76	50.6%	7.68 ± 2.68	7.0 (6.0)	4358.0	<0.001$^{\pi}$
	Females	74	49.3%	12.7 ± 5.55	11.0 (10.0)		
LA Groups	Submucosal before IANB	50	33.3%	9.96 ± 5.43	9.0 (6.0)	7.93	0.019*
	Topical before IANB	54	36.0%	9.26 ± 4.79	7.0 (6.0)		
	Simple INAB	46	30.6%	11.43 ± 4.59	11.0 (7.0)		
	Overall	150	100%	10.16 ± 5.00	9.0 (6.0)		

DISCUSSION

Pain during IANB can be attributed to the needle puncture, pressure from the injected solution, or an inadvertent intravascular injection. Rapid deposition can also lead to pain due to tissue distension. Pael *et al*. found that topical anesthetics significantly reduced needle insertion pain. However, their effect on deep tissue pain during solution deposition remains controversial.[3] Submucosal injections are more invasive than topical applications, delivering the anesthetic agent deeper into the mucosal tissues. Kaushik *et al*. demonstrated that submucosal injections using agents like lidocaine before the IANB can significantly reduce pain during IANB. This may be due to the added depth of anesthesia compared to topical applications.[13] The mean self-reported pain severity (VAS scores) reported in the literature ranged between 2.5 and 7, consistent with the present study. The mean VAS score reported during IANB in this study was 3.95, indicating moderate pain levels in the majority of the respondents, and the lowest scores were reported in the respondents given topical anesthesia before IANB.

The relationship between anxiety and pain perception during dental procedures is well-established. According to Ahmad *et al*., anxiety can heighten the perceived pain during IANB and other dental procedures. Thus, techniques to minimize pain can also potentially reduce

anxiety. Prior research has shown that mean MDAS scores ranged between 10.11 and 13.2 during IANB. According to the current study, the average MDAS score was 10.16, consistent with previous literature, and fell within the moderate anxiety level range.[13-15]

Previous studies have suggested a gender and age difference in pain and anxiety perception, with females and younger age groups reporting higher pain and anxiety levels.[16-18] The findings of this study were consistent with the previous research, highlighting higher pain perception and anxiety levels in females and younger age groups during IANB administration. The higher pain levels can be attributed to women and children being more expressive, and their fear of treatment may aggravate their perception of pain. Studies have shown that pain-related anxiety can increase the perceived pain intensity through hippocampal neurochemical activity.[19] Therefore, it is essential to reduce pain-related anxiety using topical or submucosal anesthesia before the IANB. Moreover, anxiety reduction protocols hold paramount importance in decreasing uncomfortable experiences for patients, especially women and children.[20]

One intriguing finding from the current study that was inconsistent with the literature is that the middle-aged group experienced higher anxiety levels than the younger group. This variation could result from factors such as long waiting times, hospital environment, fear of the unknown, and operator bias. The lower anxiety levels in older age groups can be attributed to mental maturity, more life experience, and the fact that older people with geriatric conditions are more familiar with hospital settings.[21,22]

Topical anesthesia significantly reduces discomfort associated with dental injections.[23] The current study showed that when the topical anesthetic was administered before IANB, most subjects experienced mild pain and anxiety, showing that topical anesthesia has effectively reduced pain perception compared to submucosal anesthesia. Moreover, it has psychological advantages as the patient does not have to undergo the prick of submucosal injection before IANB.[24]

CONCLUSION

Lower pain and anxiety levels were reported in the patients who were given topical anesthesia before IANB, making it the best possible technique for reducing pain and anxiety prior to IANB. However, anxiety reduction protocols must be thoroughly followed while giving local anesthesia to all patients. Anxiety reduction protocols, along with the use of topical anesthesia or submucosal anesthesia before administering nerve block, can effectively reduce pain and anxiety-associated pain perception in patients.

LIMITATIONS

Limited literature is available on this topic. The limitations of the present study were limited settings and sample size, which were managed using a systematic sampling technique. Moreover, pain and anxiety were measured using self-reported scales (VAS and MDAS), which are subjective and can be influenced by individual pain tolerance, previous experiences, and the ability to understand and use the scales properly. Furthermore, other factors that could influence pain and anxiety, such as the duration of the procedure, the skill level of the practitioner, or the patient's mood on the day of the procedure, were not controlled or accounted for in the study.

SUGGESTIONS / RECOMMENDATIONS

To assess the long-term effects of different anesthetic techniques on pain and anxiety using longitudinal studies would be valuable. These studies could provide insights into the duration of the anesthetic effects and any potential long-term benefits or drawbacks. Including a broader geographic and demographic patient population in future studies could enhance the generalizability of the findings. Considering the significant impact of dental anxiety on patient experience, incorporating psychological interventions or counseling, especially for patients with high anxiety levels, could be beneficial. Exploring the use of new technologies or innovative methods in administering local anesthesia could offer insights into more effective or patient-friendly approaches. Moreover, dentists and oral surgeons could benefit from training programs that emphasize pain management and patient communication.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare no conflict of interest.

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