IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 19, Issue 7 Ser.12 (July. 2020), PP 06-13
www.iosrjournals.org

Evaluation of lavender oil as a topical analgesic agent before dental anaesthesia through pain rating scales – An in vivo study

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Abstract:

Background*: Though local analgesia is used to alleviate pain and render dental procedures comfortable, its administration using injectable mode of delivery itself induces pain. Chemically derived analgesic agents are frequently used to achieve topical analgesia before or during dental procedures. However, few herbal agents are observed to show anesthetic properties. One such agent described in literature but evaluated minimally in medical and dental field is lavender oil. The present in-vivo study was planned to compare and evaluate efficacy of essential oil (lavender oil) against 20% benzocaine gel as topical analgesic agent in order to minimize pain before or during injecting local anesthesia.*

Materials and Methods*: 50 children between 6-14 years, requiring bilateral extraction of maxillary teeth through local infiltration anesthesia were selected in this study. One side was anesthetized with benzocaine gel (20%) followed by local infiltration and other with lavender oil (100%) followed by local infiltration analgesia. The effectivity of these test agents as topical analgesia was evaluated with the help of Visual Analogue Scale (VAS), Wong-Baker Scale (WBS) & Sound Eye Motor Scale (SEM).*

Results*: The mean score of VAS for benzocaine was 0.48±0.79 (p=0.0001) and lavender oil, 0.04±0.20 (p<0.001) respectively. Mean score of WBS for benzocaine was 0.68±0.93 (p=0.0001) and 0.00±0.00 for lavender oil (p<0.001). Mean score of SEM for benzocaine was 3.48±1.26 (p>0.35) and 3.64±1.11 (p>0.05) for lavender oil.*

Conclusion: *Lavender oil showed better efficacy than benzocaine gel to reduce perception of pain during local infiltration anesthesia. It can be effectively used as substitute to chemically derived anesthetic agents for effective topical analgesia.*

Key Word*: Benzocaine, Lavender oil, pain perception, topical analgesia. .*

Date of Submission: 09-07-2020 Date of Acceptance: 26-07-2020

I. Introduction

In modern dentistry, controlling the pain related to procedures is an important part of day to day practice [1]. In terms of tackling similar scenario in pediatric dentistry, it displays a major part of child behavior due to previous painful experiences associated with hospitals, and becomes an important tool in instillation of positive attitude of pediatric patients towards dentistry [2]. Administration of anesthetic agent is a prerequisite to reduce pain perception and alleviate patients' discomfort while introducing local analgesia [3] agent to the operating site. Traditional and commonest modality for the same necessitates insertion of needle in close vicinity to nerve supplying the area and tissues to be operated. However, it is sardonic to experience the pain to control it, inducing fear and anxiety in dental patients during procedures. Hence, it has becomes important over the time to find an optional strategy for introducing local analgesia solution in a more painless way for pediatric patients. Clinicians all over the world are in a quest to seek a painless method to administer local anesthesia.

Chemically derived analgesic agents are frequently used to achieve topical anesthesia before or during dental procedures. These agents have been proved highly advantageous in such endeavors. Topical anesthetics alter the pain perception and ultimately the reaction of an individual [4]. These agents block transmission of pain signals from the terminal nerve endings to sensory pain centers. Their effects are limited only the

superficial layers of mucosa or skin to control pain stimuli [3]. Thus, they become an important prerequisite for many pediatric dental procedures before needle penetration for securing local anesthesia. Considering particularly pediatric dentistry, benzocaine (20%) is one of the most widely used agents [5]. Till now, numerous in-vitro and vivo studies have been conducted to test efficacy of benzocaine with varying designs and conflicting results. Few of them have quoted favorable results, whereas others have shown that benzocaine to be ineffective [6,7,8].

Evidences from allied medicinal sciences have discussed role of preparations from few herbal plants, and essential oils like clove oil, eugenol, lavender oil, as well as thymol as topical analgesic agents[9]. The one such essential oil, lavender oil has been described in the literature, as an aromatherapy agent, have proved to decrease anxiety and alleviate pain during administration of local anesthetic agent in dental operatory[10,11]

The main constituents of lavender oil are linalool, linalyl acetate, 1,8-cineole, -ocimene (usually both cis and trans-), terpinen-4-ol and camphor. Each of these constituents can vary significantly in oils derived from different cultivars with the relative levels of each being the main determinant of market value, application and aroma. Among the properties mentioned for lavender oil, few included are; antibacterial, antifungal, sedative, carminative (smooth muscle relaxing), anti-depressive and effective for burns as well as insect bites [10].

Lavender oil is prepared, from both the flower heads and foliage through the method of by steam distillation, which causes change in its compositions drastically still maintaining sweeter aroma as that of the flowers (McGimpsey and Porter, 1999) [10]. In one study, authors found that lavender inhalation was associated with significantly reduced BIS (bispectral index) values and stress levels in volunteers. In addition, aromatherapy reduced perception of pain intensity related to needle insertion [12]. Alternative holistic therapeutic methods conducted in few experimental studies, utilized lavender oil in terms of aroma therapy to manage pain as well as to control post-operative nausea and vomiting and reduce the demand for opioids in the immediate postoperative period [13,14]. The pure quintessence of plants (essential oils) when used accurately and safely helps to provide psychological as well as physiological benefits too. Traditionally, this oil has been used for providing comfort, as a carminative and sedative agent [10]. The essence of lavender oil at the waiting lounge helps to effectively decrease the patient's apprehensions. Such practices at day to day basis usage may enhance the quality of dental treatments at psychological levels [15]. To our knowledge, there are no studies that have investigated lavender oil as a topical analgesic agent before needle insertion to achieve local infiltration anesthesia. In this study, we aimed compare and evaluate the topical analgesic efficacy of benzocaine gel 20% and lavender in relation to reduce pain perception associated with needle insertion as well as injecting local infiltration anesthesia.

II. Material And Methods

1. **Sample size determination:**
   The study was conducted on 50 children (both male and female) from out-patient department aging between 6-14 years attending the department. Samples were selected without differentiating of sex, race and ethnic characteristics. After gaining approval from institutional ethical committee, MIDSR/STU/PG/560/957/2018, patients were selected for experimental study after gaining fully informed written consents. Patients were informed about the structure of the study carefully. During the first visit, an intraoral screening was performed. Patients requiring infiltration analgesia for bilateral extraction of the maxillary teeth were included in the study. The 50 selected children teeth were divided into 2 groups.
2. **Test agent used:** Each group was assigned to one of the test agents as shown in table 1.

Group	**Test agent**
Group 1	Benzocaine gel 20%
Group 2	Lavender oil 100%

Product: 20% Benzocaine gel
Batch No: 17118
Manf. Date: 05-2017
Exp.Date: 04-2019
Benzocaine USP20%w/w in a water soluble base consisting of polyethylene glycol300, polyethylene glycol 3350, sodium saccharin and mint flavor.

Product: Lavender Oil 38/40 Super (100%) pure
Batch : 160712/31/V-8/.140
Manf. Date: Jun-2016
Shelf Life: Best before 60 months from the date of manufacturing**.**

Aspect liquid colour clear with a tinge of yellow odour sweet refreshing, floral herbaceous camphoraceous nature, with balsamic woody density 20degC: 1.4600 Refractive Index 1.459 - 1.470 @ 20C Optical rotation 20degC: -9.80deg Solubility in ethanol (90.c) 1:5 in 70% EtOH (20.c) (V/V)

Inclusion criteria:

1. Requiring infiltration analgesia for bilateral extraction of maxillary teeth.
2. Between the age group of 6-14years
3. Patients willing to participate in the study
4. Patients available during the study
5. Patients able to follow instructions.

Exclusion criteria:

1. Bleeding disorders History of allergy to any of the components of the agents to be used in the study
2. Abscess in the area of the study
3. Bleeding disorders
4. Immunocompromised subjects
5. Presence of genetic/systemic diseases that may compromise the health of the oral mucosa
6. Extremely anxious and fearful subjects
7. Presence of perceptual motor problem
8. Presence of behavioral problems.

3. Materials used for the study:

20%Benzocaine gel
Lavender oil
Cotton
Cotton buds
Gloves
Sterile standard 27 gauge needle (short)

Procedure methodology

The procedures were explained both to the parents and the child. Cotton was used to dry the mucosa. All 50 children received both Benzocaine gel and Lavender oil application for 5 minutes before infiltration analgesia. On one side benzocaine gel was used and on other side lavender oil was used as a topical analgesic agent before injecting local anesthesia. The efficacy of these two materials was evaluated using VAS (fig.1), WBS (fig.2) & SEM (fig.3) Scale.

The participants were - sight-blinded and both the materials (benzocaine and Lavender oil) were applied on the cotton roll before the trial began. On the dental chair, the participants were laid down comfortably. Then, the first test material was applied gently on a cotton roll, as directed by random data sheet. The mucosa was dried before material application. The gingiva covering an area of about 1.5 cm in diameter superior to buccal mucosa, the material was applied for 5 mints. After that test agent was reapplied as there may be washout of material by saliva.

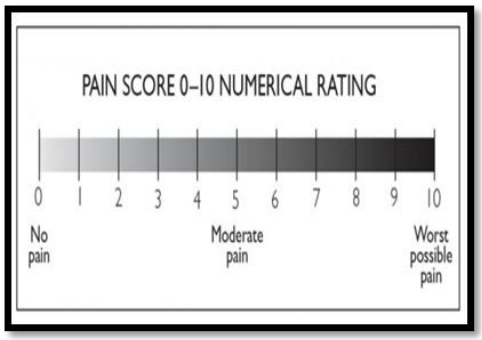


Fig 1 : Vsiual anlogue scale

Fig 2 : Wong-Baker Faces pain rating scale

After that the cotton roll and excess material were removed and the needle stick was done 3 mm superior to the mucogingival border. A 25-gauge needle was used for needle sticks, it was inserted until bony

contact achieved and then withdrawn. The participants were then asked to uncover their eyes and to rate pain on the pain scale and other test agent applied in next visit [16].

The participants were allow to use of a 10-mm visual analogue pain scale (VAS), where 0 indicated ‘‘no pain at all’’ and 10 indicated ‘‘unbearable pain’’. Two different scales per trial were rated by the participants. The score was then measured in millimeters. On next appointment the second agent was then used on the left side with the same procedure to complete the trail. After the end of the trial procedure, the participants were asked to report if any changes or symptoms were felt in the areas of material application.

OBSERVATIONS OF POSSIBLE INDICATIONS OF PAIN	COMFORT OR PAIN LEVEL			
	1—Comfort	2—Mild Discomfort	3—Moderately Painful	4—Painful
Sound	No sounds indicating pain	Nonspecific sounds; possible indiction of pain	Specific verbal complaints (such as "Ow!"), raises voice	Verbal complaint indicates intense pain (such as screaming, sobbing)
Eye	No eye signs of discomfort	Eyes wide, show of concern, no tears	Watery eyes, eyes flinching	Crying, tears running down face
Motor	Hands relaxed; no apparent body tension	Hands showing some distress or tension; grasping of chair owing to discomfort, muscular tension	Random movement of arms or body without aggressive intention of physical contact, grimacing, twitching	Movement of hands to make aggressive physical contact (such as punching, pulling head away)

Fig 3: Sound eye motor scale

Statistical analysis

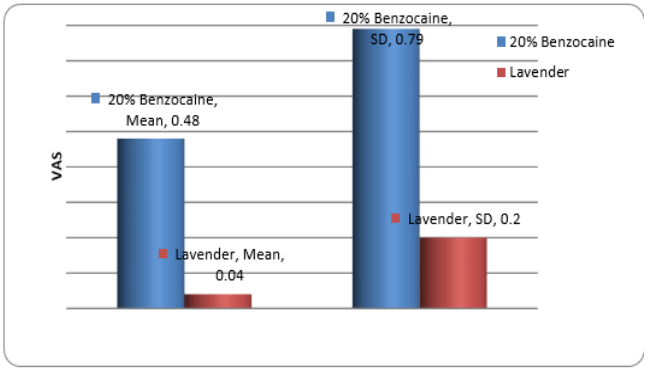
Obtained data was tabulated and analyzed by using SPSS 19.0 version IBM USA. Qualitative data was expressed in terms of proportions. Quantitative data were expressed in terms of mean and standard deviation. Comparison of mean and SD between two groups was done by using ‘unpaired t test’ to assess significance between the groups. Descriptive statistics of each variable was presented in terms of mean, standard deviation, standard error of the mean.

III. Result

Table 2 & graph I show that the mean value of 20% Benzocaine gel was 0.48 and that for lavender 0.04, which showed p-value < 0.001 Highly Significant changes in value for visual analogue scale for lavender, it means lavender has more ability to reduce pain perception than benzocaine. Table 3 & graph II shows that the mean value of 20% Benzocaine gel was 0.60 and that for lavender 0.00, which showed p-value ≤ 0.001. Highly Significant changes in value for Wong Baker pain rating face scale, which showed significant less pain perception for the lavender compare to Benzocaine gel, but in table 4 & graph III shows that the mean value of 20% Benzocaine gel was 3.86 and that for lavender 3.64, which showed p value is >0.05 not Significant changes in value for sound eye motor scale, it means there was no significant pain perception changes for the lavender compare to Benzocaine gel.

Table no 2: Comparison of mean VAS score

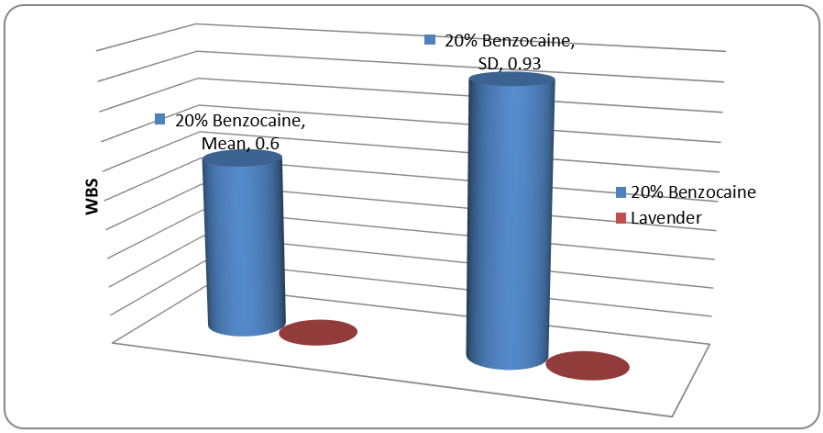
		Mean	SD	Unpaired t test	Df	P	Inference
VAS	20% Benzocaine	0.48	0.79	3.82	98	0.0001	Highly Significant
	Lavender	0.04	0.20			< 0.001	



Graph I: Comparison of mean VAS score

Table no 3 : Comparison of mean WBS score

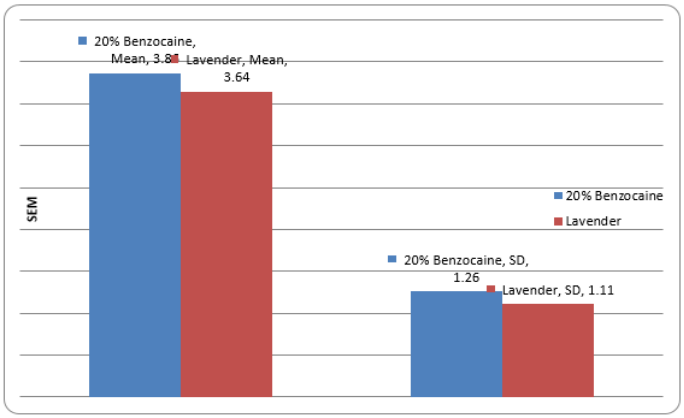
	N	Mean	SD	t	df	p	Inference
WBS	20% Benzocaine	.60	.93	4.583	98	.0001	Highly Significant
	Lavender	.00	.00			≤ 0.001	



Graph II: Comparison of mean WBS score

Table 4: Comparison of mean SEM score

		Mean	SD	T	df	P	Inference
SEM	20% Benzocaine	3.86	1.26	0.92	98	.35	Not Significant
	Lavender	3.64	1.11			>0.05	



Graph III: Comparison of mean SEM score

IV. Discussion

Various dental procedures require use of injectable local anesthetic agents to minimize patient's pain and optimize clinical performance of dental practitioners. From the experiences of childhood, prick of the injection needle becomes a by-default painful experience, for which most of the children are fearful about. Hence, particularly in pediatric patients, it becomes essential to use adjunctive therapeutic aid that will help to reduce pain perception during needle insertion and local anesthetic deposition whenever required. Various topical analgesic agents are used efficiently to reduce pain associated with needle insertion in children. The most commonly used topical analgesic agent, benzocaine (20%) has been observed to be slightly better than lignocaine spray (10%) and EMLA cream to achieve buccal mucosal analgesia [18]. Benzocaine, demonstrates rapid onset of action through the mechanism of nerve membrane expansion [17] has a fast onset of action which is of great advantage in pediatric patients [19]. While injecting local anesthetic agents, topical analgesic agents can be used effectively in pediatric patients for behavior management and pain reduction. These include various gels, spray and solutions containing lignocaine or benzocaine. Pertaining to the drawbacks such as bitter taste and bad smell, new therapeutic agents are being investigated. Few of them include natural herbal agents like clove oil [19] and some essential oil derivatives [10].

Alqareer et al. conducted an experimental study on 73 adult volunteers to investigate topical analgesic efficacy of homemade clove gel on buccal mucosa against benzocaine (20%) gel. They observed that homemade clove and benzocaine gel were similarly effective [19]. Koppolu et al, investigated topical analgesic effect of procaine gel, benzocaine gel and lignocaine spray through visual analogue scale and observed procaine gel to have best topical analgesic effect than other two[20]. Dagli et al, reviewed therapeutic properties of essential oil and their implications in dentistry. They noted that among the essential oils, lavender oil has better efficacy due to the major components found, i.e linalool, linalyl acetate, 1,8cineole, bocimene, terpinen4ol, fenchone, camphor, and viridiflorol. But the compositional concentrations can vary from specie to species. The relative level of each of these constituents varies in different species. Lavender oil, is usually derived by stem distillation of Lavandula angustifolia flowers (Family: Lamiaceae) comprising predominantly linalyl acetate (3, 7dimethyl1, 6octadien3yl acetate), linalool (3,7 dimethyl-octa 1,6 dien-3-ol), lavandulol, 1, 8-cineole, lavandulyl acetate, and camphor. In lavender oil linalool is the principal active agent [21].

In our study, we evaluated topical analgesic efficacy of lavender oil against benzocaine gel (20%), and found that the mean score for pain perception due to lavender oil was significantly less as compare to benzocaine gel when compared through VAS, WBS & SEM. Even after extensive literature search about usage

of lavender oil as a topical analgesic agent, we could not find any study reporting such use. However, it has been used in numerous experimental studies as an aromatherapy agent to reduce anxiety and increase pain perception threshold. Kim et al. studied effect of lavender oil fumes coated on oxygen mask to reduce BIS (bispectral index) value by minimizing stress and associated with needle insertion in 30 participants. They observed that the stress and BIS value for perception of stress got reduced significantly ($p<0.001$) when compared against control during aromatherapy. In addition, the pain intensity associated with needle insertion was significantly decreased after aromatherapy compared with the control ($p<0.001$) [12].

Cavanagh et.al studied the biological activities of lavender oils and stated that, various biological benefit can be achieved through oral administration, massage or aromatherapy. Lavender oil also imposes various physiological effects apart from psychological one, which predominantly includes aromatherapy. The aforementioned effects are achieved through inhalation of volatile compounds that affects limbic system, in particular the amygdala and hippocampus region of CNS [10]. Kasper et.al reported that Silexan, an oil preparation of lavendula when administered orally helps to reduce subsyndromal anxiety disorder. Clinical trials conducted to investigate the effectiveness of oral lavender oil preparation (silexan), proved to demonstrate anxiolytic effect. Also, it was found to improve symptoms like restlessness, disturbed sleep and somatic complaints and provided general well-being as well as quality of life during treatment [28,29]. However, the central nervous system depressive effects of lavender oil were discussed by Jager et.al, who reported that Linalool and linalyl acetate penetrates the skin rapidly and is absorbed in systemic circulation when applied topically causing CNS depression [27]. Zabirunnisa, et al. noted that aroma of lavender has an ability to minimize anxiety state but not a tool for treatment of anxiety, providing favorable evidence to use of lavender fragrance in dental settings at a low cost. This can become a simple intervention to alleviate anxiety in dental patient. The results can be generalized to patients with levels of dental anxiety below the level of phobia who are attending the general dental clinics. However, they have advised extended research on a large scale for evaluating the effectiveness of essential oils in reducing dental anxiety [15]. Ghelardini et al. demonstarted L. angustifolia oil, linalyl acetate and linalool to retain anesthetic activity both in pre-clinical and clinical experimental set up [23]. Re et al explained action of linalool, through inhibition of acetylcholine release at neuromuscular junction altering ion channel function [24]. Tisserand et al. stated that results seen in aromatherapy are due to both the psychological effect of the odor and the physiological effects of inhaled volatile compounds of lavender, that act via limbic system, specifically the amygdala and hippocampus. While the exact intracellular mechanism of action is yet to be understood completely, but anticipated to be similar to benzodiazepines that enhance effects of gamma-aminobutyric acid in the amygdala [25].

When mean VAS score of benzocaine was compared against lavender oil respectively, it was observed that benzocaine gel demonstrated higher scores compared to lavender which was highly significant ($p<0.001$), while the comparison of mean WBS score showed less scoring for lavender oil which was highly significant. The mean of SEM showed no significant changes in values. In this study, lavender oil showed less score in all pain rating scale as compared to 20%benzocaine gel, so lavender oil can be used as an effective topical anesthetic agent, but more sample size required for the same.

Lehrner, et.al observed that in dental operatory using ambient fragrances of orange and lavender reduced anxiety as well as improve mood. Kritsidima et.al in their cluster randomized –controlled trial demonstrated effects of lavender fragrance on operatory anxiety levels of dental patients; They found that lavender fragrance reduced patient's anxiety in dental operatory and has no effect on dental visits required for further treatment [29,30]. Braden et.al observed that utilization of Lavandin helps to reduce preoperative anxiety in surgical patients, which was analyzed through visual analog scales for assessing anxiety. The result suggested use of lavender as a simple, low-risk, cost effective, intervention with high potential to reduce preprocedural anxiety [31].

V. Conclusion

It was concluded from the study that lavender oil has less pain perception scores of all pain rating scale compare to Benzocaine gel. Benzocaine gel and lavender oil were effective anesthetic agent which significantly reduced the pain perception associated with the intraoral injection. Lavender oil showed significantly higher efficacy as compared to benzocaine gel. Lavender oil can be a better alternative to benzocaine gel as an effective topical analgesic agent as lavender has a sweet odor which reduces anxiety and have an anesthetic property, for which more research is required.

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