Lidocaine versus Mepivacaine in Sedated Pediatric Dental Patients: Randomized, Prospective Clinical Study

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Dental anxiety is usually seen in the pediatric patients. specially in the case of minor oral surgical procedures and exodontia, cooperation of the patients and their families with the dentist will lead to superior treatment outcomes. Pain control is important in dentistry. The ***aim*** *of this randomized prospective clinical study is to compare the local anaesthetic and haemodynamic effects of 2% lidocaine (Group 1) and 3% mepivacaine (Group 2) in sedated pediatric patients undergoing primary tooth extraction.* ***Study design****: 60 pediatric patients undergoing sedation for elective primary tooth extraction was prospectively included in the study in a randomized fashion. Inclusion and exlusion criteria were assigned. Patients were given premedication via oral route. Local anesthesia was achieved before extraction(s).* ***Results****: There were no significant differences between the groups in patient demographics, number of teeth extracted, duration of the operation and time from the end of the procedure to discharge (p>0.05). FLACC pain scale scores were not statistically significant between the groups, except at 20 minutes post-operatively when the score is significantly lower in Group 2 (p=0.029).* ***Conclusion****: Prevention of pain during dental procedures can nurture the relationship of the patient and dentist. Tooth extraction under sedation in pediatric patients could be safe with both local anesthetics.*

Key words: *Lidocaine, Mepivacaine, Sedation, Anxiety, children.*

INTRODUCTION

Dental anxiety is common in the pediatric population. Patients who can not be managed with behavior modification should be treated under sedation that will contribute towards a comfortable treatment.[1] Especially in the case of minor oral surgical procedures, cooperation of the patients and their families with the dentist will lead to superior treatment outcomes. Since pediatric patients may show excessive reactions to injections, oral route for premedication is usually preferred in this group. Besides, oral administration of drugs is an easy, low cost and safe technique that has been in use for years.[2] Midazolam is the drug of choice for dental treatments under sedation, as it can be administered orally, reduces anxiety, allows a smooth separation from the parents, facilitates induction of anesthesia, reduces post-operative behaviour problems, has wide safety margins, partial anterograd amnesic effect, and a short elimination life.[3] Sedation helps to establish a steady surgical field allowing the dentists to work comfortably, however per-operative pain control also needs addressing. Effective pain control is critical in dentistry since painful treatment is shown to be an important etiological factor leading to dental fear.[2]

Local anesthesia is reversible inhibition of nerve conduction, caused by noxious stimuli in a particular area of peripheral tissues. Lidocaine HCl is the first amide local anesthetic that is synthesized by Löfgren in 1943 and approved by Federal Dental Association (FDA) in 1948.[3] Lidocaine is widely used in dentistry and represents a gold standard in comparative studies of local anesthetics.[4,5]

Lidocaine causes vasodilatation, for this reason it is commonly used with adrenaline to slow down absorption by vascular structures and to increase the duration of local anesthesia. Mepivacaine is considered to be an important anesthetic agent for its minimal vasodilating properties and is capable of promoting profound local anesthesia. On the other hand, mepivacaine without vasoconstrictor produces a short period of soft tissue anesthesia.[6]

Among the several commercially available anesthetic solutions, lidocaine is one of the most frequently used in dentistry, being the benchmark for comparison. It is an amide anesthetic with a short onset of action and an intermediate duration of anesthesia when associated with adrenaline. It has been shown that lidocaine and mepivacaine, which is also an amide anesthetic, in the same

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concentrations and with the same vasoconstrictors have a similar effect. In the reviewed literature, however, there are few studies comparing both anesthetics in relation to the postoperative effects, pain reduction and the patient's comfort.[7]

Patient inflicted postoperative soft tissue injury (especially lip and cheek biting) is a well-known complicaton of dental local anesthesia.[8] Therefore application of local anesthetics with shorter durations reduces the risk of lip and cheek biting as perception of pain returns faster.

The aim of this randomized prospective clinical study is to compare the local anesthetic and hemodynamic effects of Lidocaine HCl 2% with 1:100000 epinephrine and Mepivacaine HCI 3% in sedated paediatric patients undergoing exodontia.

MATERIALS AND METHOD

The study was approved by the local Ethics Committee, and 60 ASA I pediatric patients scheduled for elective tooth extraction under sedation were prospectively included in the study in a randomized fashion.

The study was conducted in the one-day unit of Oral Surgery Department in the School of Dentistry, Ege University. Inclusion criteria were;

- Patients aged 6 to 12 that require a maximum of three maxillary primary teeth extractions with similar surgical difficulty under local anesthesia.
- A preoperative anxiety score of "negative" or "definetely negative" according to Frankl Behavior Scale (This is based on observation and scoring of children's behavior. Behavior of a child is evaluated under four groups, namely "definitely negative", "negative", "positive" and "definitely positive")

Exclusion criteria were: Patients with acute or sub-acute dental abcess; patients who used analgesics within the last 5 hours before extraction; patients with a history of bleeding disorders and allergic reactions to analgesics or any of the drugs tested.

The level of anxiety was assessed using Frankl Behavior Scale pre-operatively. This is based on observation and scoring of children's behaviours. Behavior of a child is evaluated under four groups, namely "definitely negative", "negative", "positive" and "definitely positive". Accordingly children who sustain a negative or definitely negative behavior pattern even after utilization of behavior management techniques were planned for dental extraction under sedation. Written and verbal informed consent of the legal guardian of patients were obtained and fasting was started 6 hours pre-operatively. Patients were served to drink 5ml of sour cherry juice mixed with 0,75 mg/kg midazolam as a premedication. Assessment according to Ramsey Sedation Scale was started immediately and patients scoring 3-4 were moved to dental chair for monitorization.[9]

Randomization was done by a computer generated list and patients were assigned to receive either Lidocaine HCl 2% with 1:100 000 epinephrine (Group 1) or Mepivacaine HCl 3% (Group 2). Study drugs were given by a trained oral surgeon. For the purpose of creating double-blind conditions neither the anaesthetist who attended clinical applications and observations nor the parents were informed as which drug was administered to which child. Local anesthesia was achieved by infiltration of the local anesthetic at a maximum dose of 3mg/kg. If three adjacent teeth were to be removed, infitrations were done to the most distal and proximal teeth, omiting the one in the middle. Extraction(s) were carried out 5 to 7 minutes following completion of local anesthetic injections and confirmation of the absence of pain on pain prick testing of the mucosa. Peripheral arterial oxygen saturation (SpO_2), systolic (SAP) and diastolic (DAP) arterial pressure and heart rate (HR) were recorded every 3 minutes after the first injection until completion of the procedure. Side effects associated with midazolam use, arterial oxygen desaturation below 93% were recorded and treated accordingly. The child's age and weight, type of the local anesthetic and duration of the procedure were recorded. Post-operative pain was assessed according to the Face, Legs, Activity, Cry, Consolability (FLACC) pain scale for an hour every 10 minutes (Table 1).[10] Each parameter was rated on a scale of 0 to 2. When the sum of the pain parameters exceeded 4, appropriate analgesics were administered. Side effects like nausea, vomiting, agitation during recovery, double or blurred vision post-operatively were recorded. Patients were discharged two hours after the procedure and a next day review appointment was arranged to look for signs and symptoms of soft tissue trauma that could occur secondary to lip and cheek biting.

Statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS) for Windows (version 13.0; SPSS Inc., Chicago, IL, USA). Study was designed using a G-Power analysis to estimate sample size for each group. Accordingly,

Table 1. FLACC pain scale

Categories	Scores		
	0	1	2
Face	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant quivering chin, clenched jaw
Legs	Normal position or relaxed	Uneasy, restless, Tense	Kicking, or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
Cry	No cry (awake or asleep)	Moans or whimpers; Occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, Relaxed	Reassured by occasional touching, hugging or being talked to, distractible	Difficult to console or comfort

for a power level of 80%, the sample size needed was calculated to be 15, 17 and 26 for SAP, HR and DAP parameters respectively. Alpha was set to 0.005. Therefore considering the possible dropouts from the study, a sample size of 30 was decided to be appropriate for each group. Patient demographics, number of teeth extracted, duration of the operation, time to discharge, side effects and FLACC pain scale were analyzed by Chi-square test. Hemodynamic responses were analyzed using the repeated measures analysis of variance (ANOVA). A value $p<0.05$ was considered to be statistically significant.

RESULTS

Each group contained 30 patients. There were no significant differences between the groups in patient demographics, number of teeth extracted, duration of the operation and time from the end of the procedure to discharge ($p>0.05$) (Table 2).

The mean basal HR was 114.10±9.3/min in Group 1 and 117.80±13.53/min in Group 2 (p=0.22). The mean basal SAP was 83.07±10.75 in Group 1 and 81.70±7.01 in Group 2 (p=0.56). The mean basal DAP was 46.67±5.95 in Group 1 and 46.80±6.10 in Group 2 (p=0.93). The mean basal SpO_2 was 97.87±1.59 in Group 1 and 98.40±1.35 in Group 2 (p=0.16). There were no significant differences between the groups basal hemodynamic values.

The mean values of hemodynamic parameters of both groups are shown in Table 3.

The mean SAP values recorded during the procedure were significantly lower than the mean basal SAP values within both groups (p=0.002). However there were no significant differences between the groups (p=0.546).

Table 2. Characteristics of the two trial groups

	Group 1 (Lidocaine)	Group 2 (Mepivacaine)	p
Number of patients	30	30	
Age (year)	7.7±1.4	7.5±1.7	0.68
Weight (kg)	28.4±6.3	25.4±6.4	0.07
Gender (male/female)	12/18	13/17	0.79
Number of the teeth extracted			0.35
1 extraction	11	10	
2 extraction	8	13	
3 extraction	11	7	
Duration of the operation (min)	5.3±2.5	5.2±2.4	0.79
Time to discharge (min)	65±6.8	66±8.1	0.6

Table 3. The mean values of hemodynamic parameters

	Group 1 (Lidocaine)	Group 2 (Mepivacaine)	p
SAP	80±7.6	79±6.2	0.81
DAP	43.8±4.9	42.3±4.2	0.2
HR	109.7±9.4	114.7±10.4	0.6

The mean DAP values recorded during the procedure were significantly lower than the mean basal DAP values within both groups (p=0.00). However there were no significant differences between the groups (p=0.575).

The mean HR values recorded during the procedure were significantly lower than the mean basal HR values within both groups (p=0.013). However there were no significant differences between the groups (p=0.073).

None of the patient experienced hypoxia (arterial oxygen desaturation below 93%).

FLACC pain scale scores were not statistically significant between the groups, except at 20 minutes post-operatively when the score is significantly lower in Group 2 (p=0.029) (Table 3) None of the patients required supplemental analgesia during the monitoring period and no side effects of the drugs used were detected. Patients or the legal guardians did not report post-operative pain on the next day review appointment.

DISCUSSION

Primary teeth extraction is a frequently performed procedure in oral surgery. Management of these cases require efficent utilization of behavior management and local anesthesia techniques. Prevention of pain during dental procedures can nurture the relationship of the patient and the dentist, building trust, allaying fear and anxiety, and promoting a positive dental attitude. The technique of local anesthetic administration is an important consideration in behavior guidance of pediatric patients. Age-appropriate "nonthreatening" terminology, distraction, topical anesthetics, proper injection technique, and nitrous oxide/oxygen analgesia/anxiolysis can help the patient have a positive experience during the administration of local anesthetics.[11,12] Pediatric dental surgeon should be aware of proper dosage (based on weight) to minimize the risk of toxicity and the prolonged duration of anesthesia, which can lead to accidental lip or tongue trauma.[8] The dose of the local anesthetic used in this study was appropriate for this age group while providing adequate local anesthesia.

This study revealed that mepivacaine was superior to lidocaine in controlling post-operative pain at 20 minutes (p=0.029).

Table 4. FLACC pain scale scores

FLACC SCALA	Median (min-maks)	p
10. min Lidocaine	1.5(0-3)	0.877
10. min Mepivacaine	2(0-3)	
20. min Lidocaine	2(0-3)	0.029*
20. min Mepivacaine	1(0-3)	
30. min Lidocaine	1(0-3)	0.906
30. min Mepivacaine	1(0-3)	
40. min Lidocaine	1(0-2)	0.185
40. min Mepivacaine	0(0-2)	
50.min Lidocaine	0(0-1)	0.277
50. min Mepivacaine	0(0-1)	
60.min Lidocaine	0(0-1)	1,00
60. min Mepivacaine	0(0-1)	

*p<0.05 :statistically significant.

However post-operative pain control at other times and hemodynamic monitoring during the procedure did not differ between the groups. Since none of the patients required analgesia, this difference at 20 minutes is not clinically significant. However when higher post-operative pain levels are expected (e.g. minor oral surgery interventions requiring dissections and bone removal) this statistical significance could be clinically significant as well. Pediatric dentist should aim for pre-operative pain control while minimizing the risk of lip and cheek biting by choosing an appropriate local anesthetic at a safe dose.[8]

Fernieni *et al* compared the haemodynamic effects of 3% Mepivacaine HCL and 2% Lidocaine with 1/100000 adrenaline in 17 healthy adult patients. The difference between mean SAP and DAP values recorded 1,2,5 and 10 minutes after local anesthetic injection in Mepivacaine HCL group were not statistically significant and the HR values at 10 minutes in Lidocaine HCL group were significantly higher.[13]

Knoll-Köhler *et al* compared the hemodynamic effects of 2% Lidocaine HCL, 2% Lidocaine HCL with 1/100000 and 1/25000 adrenaline in 20 normotensive patients aged 23 to 31 years, and they reported that mean arteriel pressure (MAP) and HR values were significantly higher in groups that were administered adrenaline containing solutions.[14] Matsumura *et al* reported that SAP and HR values were significantly higher when Lidocaine HCL with 1/80000 adrenaline was used in 40 patients aged 19 to 74.[15] In contrast we detected a significant fall in hemodynamic parameter values within both groups. This can be explained with the fact that arterial blood pressure values during minor oral surgery are influenced by anxiety and stres.[16,17,18]

Ezmek *et al* [19] compared the hemodynamic effects of plain lidocaine, prilocaine and mepivacaine solution in hypertensive patients. They concluded that hemodynamic effects of the three local anesthetic solutions evaluated in their study were similar to each other, and they could be safely used during extractions. When Lidocaine and Mepivacaine is used with the same vasoconstrictor, they have similar hemodynamic effects, and both are effective in surgical procedures lasting up to 60 minutes. There were no significant differences between the two solutions regarding the intensity of postoperative pain.[20]

In our study, sedation with midazolam prior to extractions resulted in control of anxiety and thus a fall in SAP, DAP and HR values recorded during the procedure.

The ease of application, safety and low cost makes oral route as the route of choice for administration of sedatives in the paediatric population. Midazolam, a sedative belonging to the benzodi azepine group is commonly used due to its anxiolytic properties that help separation from parents. Partial anterograd amnesia may be useful in the deletion of memories of distress. Midazolam reduces post-operative unwanted behavior. Short duration of action means faster discharges.[2]

Masue *et al* did not report a statistically significant drop of SpO_2 in 193 children that were administered 1,5 mg/kg of peroral midazolam as premedication.[21] We did not detect any signs of hypoxia or a significant drop of SpO_2 either.

Odabaş *et al* compared the analgesic effects and soft tissue anesthetic effects of 4% articaine and 3% mepivacaine in pediatric dentistry and reported no difference in analgesic and hemodynamic effects.[22] Hinkley *et al* compared the pulpal anesthetic effects of 2% mepivacaine with 1 : 20,000 levonordefrin and 2% lidocaine with 1 : 100,000 epinephrine in an experimental setting of inferior alveolar nerve block and reported similar effects.[23]

Steffens *et al* compared the analgesic effects of 2% lidocaine with 1 : 100.000 epinephrine and 2% mepivacaine with 1 : 100,000 norepinephrine after periodontal surgical interventions and found that pain scores were lower at post-operative 1st, 2nd, and 3rd hours. Pain scores were not high in either of the groups.[24] In our study it was found that mepivacaine has a superior analgesic effect at post-operative 20 minutes, however no supplemental analgesia was necessary in either of the groups.

In contrast with our study, Replogle *et al* compared 2% lidocaine with 1 : 100.000 epinephrine and 3 % mepivacaine to find that the former is a more potent local anesthetic.[25]

Numbness caused by local anesthetics can result in lip, cheek and tongue biting especially in the paediatric population. Hersh *et al*, compared the anesthetic effect of 1.8 ml of lidocaine HCL with 1/80000 adrenaline, 3% mepivacaine HCL, and 4% prilocaine HCL. In their study, deepness of local anesthesia in lower lips and tongues of 60 dentistry students following inferior alveolar blocks were assessed using a visual anolog scale. They found as we did that there was no statistically significant difference between the compared drugs.[26]

CONCLUSIONS

This is the first study to compare mepivacaine and lidocaine in sedated pediatric patients. Studies of local anesthetics for different dental treatments under sedation, are crucial for improving patient care and treatment outcome. Mepivacaine and Lidocaine have profound local anesthetic effects in sedated paediatric patients undergoing exodontia, thus can help provide a comfortable treatment. It is concluded that Lidocaine HCl 2% with 1:100 000 epinephrine and Mepivacaine HCl 3% can both be safely used in the sedated pediatric population.

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