

The Use of Computer Control Local Anesthetic Delivery Injection with Music as an Adjunct in Stress and Pain Reduction for Children

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Abstract: ***Background and Purpose:** Dental treatment involving anesthetic injection can lead to stress and pain. Computer Controlled Local Anesthetic Delivery (CCLAD) has been developed as computerized delivery system for local anesthetics in reducing dental pain. Japan is currently developing music as CCLAD adjunct known as Anaject II®. The purpose of this study is to analyze the difference of the value of stress and pain observed between CCLAD with music as anesthetic adjunct and the use of conventional syringe. **Materials and methods:** This study was conducted on 16 children (11 females & 5 males) aged 7-12 years old with purposive sampling technique. The value of stress was measured using salivary alpha amylase analysis and Wong Baker facial pain scale was used for measuring the value of pain during CCLAD anesthetic injection with music as an adjunct and conventional syringe. **Results:** The study result revealed significant difference between stress and pain value during CCLAD anesthetic injection with music as an adjunct and conventional syringe (p-Value of 0.00 and 0.04 respectively). **Conclusion:** Anesthetic injection using CCLAD with music as an adjunct is considered to be less stressful & painful compared to the use of conventional syringe.*

Keywords: CCLAD, the difference of stress and pain value, conventional syringe, salivary alpha-amylase, Wong-Baker facial pain scale

1. Introduction

Dental fear during treatment is the reaction from visual stimulus and specific in pain stimulation (needles or burs). Dental anxiety is the reaction from stress associated to dental treatment with unknown stimulus (the stimulus is not visual).^{1,2} Dental stress of children is considered to be the response towards dental treatment as the result of anxiety and pain.³

The research conducted by Milgrom et.al⁴ and Arjen & Johan⁵ suggested that injection is the primary aspect of anxiety or dental fear. The injection is the source of stress reaction resulting in children's resistance to undergo dental treatment procedures. The research from Sghaireen et.al⁶ also suggested that local anesthetic (36%) for some children is the most terrifying situation during dental treatment procedures followed by tooth drilling procedure (27%).

Pain control is an important aspect in dentistry, specifically in pediatric dentistry. The pain is controlled by the use of local anesthetic agent. Local anesthetic injection should not result in pain.^{7,8} Efforts have been made to reduce pain associated to anesthetics such as modification to chemical anesthetic agents and additional buffer agent. However, very few concerns have been given to the design of injection syringe as well as the administration methods.

Conventional syringe does not provide adequate control to the flow rate. Therefore, CCLAD system with pen-like handle enables ideal anesthetic flow rate controlled by the computer processor to compensate tissue resistance.

Injection with light and slow compression is the key to have comfortable and painless local anesthetic delivery.^{7,8,9,10} CCLAD with music as an adjunct has been developed in Japan, known as Anaject II®.¹¹ Music has the effects of distraction, relaxation, and familiarity and it also releases endorphins.

The distraction effect is believed to have ability to divert patients from the pain during dental treatment. Relaxation effect is obtained from the voice and rhythm which is believed to have calming effect. Comfort resulted from the familiarity effect also helps reduce pain during dental treatment. Music also helps stimulate the brain to release the endorphins.¹²

The research conducted by Kwak et.al¹³ reported the difference of the pain value from AMSA injection using CCLAD The Wand® and conventional syringe. However, the difference of children stress and pain values in AMSA injection using CCLAD with music adjunct, Anaject II®, and conventional method using salivary alpha amylase as well as Wong-Baker facial pain scale has not been reported until now. Local anesthetic application is a dental procedure used to control dental pain during treatment.

The purpose of this study is to investigate the children stress value resulting from injection (CCLAD with music adjunct and conventional syringe) measured by salivary alpha amylase analysis and pain value using Wong-Baker facial pain scale.

2. Materials and Methods

The subjects participated in this study were 7 to 12 years old children who had been indicated to undergo 2 primary teeth from different maxillary region using local anesthetic. Informed consent was obtained from the parents of the subjects. The ethical clearance was approved by the Health Research Ethics Committee of The Medical Faculty, Universitas Padjadjaran, Indonesia (No. 147/UN6.KEP/EC/2019). The study was conducted from February 2019 to April 2019.

The objects of this study were salivary alpha amylase enzymes to measure stress value from *Computer Controlled Local Anesthetic Delivery (CCLAD)* with music as an adjunct to the injection procedure and conventional syringe prior to and following the local anesthetic injection. Pain value was analyzed using Wong-Baker facial pain scale following the injection.

Pediatric patients who were referred to the Pediatric Dental Clinic, Rumah Sakit Gigi Mulut, Universitas Padjadjaran were selected based on sample criteria. Injection Anaject II® was given to the patients on first visit prior to the extraction of right maxillary primary teeth. Salivary alpha

amylase rate was measured prior to and following the treatment.

The increase of salivary alpha amylase rate demonstrated the stress. Pain was measured using Wong-Baker facial pain scale. The patients were instructed to show the facial expression that is most representing facial pain based on written description. The *washed out* period was decided to last for a week. Following the period, injection using conventional syringe was conducted for left maxillary primary teeth.

Statistical analysis

The difference of children stress value between CCLAD injection with music as an adjunct and conventional syringe was analyzed using paired t-test. The difference of pain value was analyzed using Wilcoxon analysis.

3. Results

The stress value prior to and following the injection of CCLAD with music as an adjunct as well as conventional syringe was obtained from measuring the rate of salivary alpha amylase (Table 1). The analysis was conducted using paired t-test.

Table 1: The Stress Value Prior to and Following the CCLAD Injection with Music as an Adjunct and Conventional Syringe

Tools	n	The Mean of Stress Value±SD		The Mean of the Difference of Stress Value (Before & After)±SD	t-value	p-value
		Before Injection	After Injection			
CCLAD with music adjunct	16	24.06±11.73	29.75±10.88	14.19±9.99	5.68	0.0000218 *)
Conventional Syringe	16	25.38±14.89	32.88±12.15	14.88±12.71	4.68	0.000147 *)

Notes:

n = Samples

SD = Standard Deviation

P Value = Confidence Level (<0,05)

(*) = Very valuable

Table 2 revealed the significant difference from the children stress value based on 2 injections of salivary alpha-amylase measured before & after treatment. The difference showed p value of < 0,05, CCLAD with music adjunct of 0.0000218 and conventional syringe of 0.000147.

The difference of stress value between CCLAD injection with music adjunct and conventional syringe was shown by Table 2. The analysis used was paired t-test.

Table 2: The Difference of Children Stress Value between *Computer Control Local Anesthetic Delivery* with Music Adjunct and Conventional Syringe

Tools	n	The mean value of of stress (before & after)±SD	The mean value of stress value difference between 2 injections±SD	t-value	P value
CCLAD with music adjunct	16	14.19±9.99	10.06±5.09	7.90	0.000000499 *)
Conventional syringe	16	14.88±12.71			

Notes: n = Samples

SD = Standard Deviation

P Value = Confidence (<0,05)

(**) = Very Valuable

Table 2 demonstrated the significant difference of children stress value between CCLAD with music as an adjunct to anesthesia and conventional syringe (p value = 0.000000499). The lower mean value of salivary alpha amylase rate before and after treatment revealed that the stress value difference before and after treatment was lower at CCLAD injection with music as and adjunct to anesthesia.

The pain value was measured using Wong-Baker facial pain scale. The degree of pain between CCLAD injection and conventional syringe was shown from Table 3.

Table 3: The Value of Pain between *Computer Control Local Anesthetic Delivery* Injection with Music as an Adjunct to Anesthesia and Conventional Syringe

Pain Value	CCLAD with Music		Conventional Syringe	
	N	%	n	%
0	4	25,00	3	18,75
2	10	62,50	5	31,25
4	2	12,50	8	50,00
6	0	0	0	0
8	0	0	0	0
10	0	0	0	0
Total	16	100,00	16	100,00

Note: n = Sample

Table 3 demonstrated the degree of pain observed from the children who underwent dental procedure using CCLAD with music with the pain degree of 0 (25% of children) ; 2 (62,5% of children); and 4 (12,5% of children). The degree of pain observed from the injection of conventional syringe was 0 (18,75% of children); 2 (31,25% of children), and 4 (50% of children).

The pain degree difference between CCLAD injection with music and conventional syringe was shown from Table 4. The analysis used was Wilcoxon test.

Table 4: The Difference of the Degree of Pain between *Computer Control Local Anesthetic Delivery* Injection with Music and Conventional Syringe (n=16)

Variable	Mean Value	Sum of Ranks	SD	Z	P Value
CCLAD with music	13.81	221	±24.56	-1.75	0.04*)
Conventional Syringe	19.19	307			

Notes:

n = Samples

SD = Standard Deviation

P Value = Confidence Level (<0,05)

(*) = Valuable

Table 4 showed significant difference of the pain value between CCLAD injection with music and conventional syringe (p value= 0.04). The mean value of pain observed from the CCLAD injection with music was lower.

4. Discussion

This study showed significant differences in stress values of children aged 7-12 years old between Computer Control Local Anesthetic Delivery (CCLAD) injection with music as an adjunct to anesthesia and conventional syringe. The mean value of salivary alpha amylase before CCLAD injection with music (24.06 U / ml) was lower than conventional syringes (25.38). The mean value of salivary alpha amylase after CCLAD injection with music (29.75 U / ml) was also lower than conventional syringe (32.88 U / ml). It can be concluded that the stress value of CCLAD injection with music is lower than conventional syringes.

Table 1 showed the lower mean difference in stress value before and after CCLAD injection with music (14.19) compared to conventional syringe (14.88). The mean value of salivary alpha amylase before and after was smaller than conventional syringe. This means that the stress difference

before and after treatment experienced by children was lower in CCLAD injections with music.

Table 2 showed a significant difference in the stress value of children between CCLAD injection and conventional syringe. The mean difference in stress value is 10.06. The study by Oktay et al¹⁴ also revealed lower anxiety levels using Spielberger's State-Trait Anxiety Inventory (STAI) observed from the use of CCLAD injection with music as an adjunct to anesthesia compared to conventional syringe.

Sumer et al¹³ and Chang et al¹⁵ stated quite contrary results. The study by Sumer et al¹³ and Chang et al¹⁵ revealed that there was no difference of anxiety levels between CCLAD injection with music and conventional syringe. CCLAD was considered as one of the factors of anxiety and stress that could lead to fear of dental treatment in the study.

Sumer et al¹³ and Chang et al¹⁵ used *Dental Anxiety Scale* (DAS) to assess the stress related to anxiety that had psychometric property. However, the scale had limitations for it was only focused on the cognitive dimension of anxiety, lacking validation, and outdated.¹⁶ Goodell et al¹⁷ stated that the anxiety assessed using *Injection Anxiety Survey* showed lower level in the use of conventional syringe compared to CCLAD. The study speculated the effect of new form of injection used in CCLAD that could lead to dental fear.

Stress in dentistry is a collection of various types of physiology and pathopsychology condition and the most common phenomenon is fear of dental treatment which may lead to fear and anxiety in some cases.^{18,19} This type of stress is commonly experienced by patients who undergo dental treatment, specifically in pediatric patients. Physiological stress can result in the effect to the sympathetic nervous system.^{20,21} Psychological pressure activating the sympathetic nervous system increases salivary alpha amylase secretion.²² Salivary alpha amylase is an accurate indicator of the response of individual with higher sensitivity.

Salivary alpha amylase enzymes are the response from the sympathoadrenomedullary system to stress, a biomarker of stress, as an alternative adrenergic activity, due to its stability.²³ Salivary alpha amylase is a strong indicator associated to stress response due to higher individual sensitivity. Salivary alpha amylase values are related to internalization (anxiety and depression) and externalization (interaction of behavioral problems). Some studies have shown that salivary alpha amylase levels can be used as non-invasive assessment indicator of the activation of the sympathetic nervous system related to stress.^{24,25,26,27,23}

This study used CCLAD injection with music as an adjunct to anesthesia known as Anaject II®. This type of injection has the effect of distraction, relaxation, familiarity, and the ability in releasing endorphins. Relaxation effect arises from the rhythm and the sound which can release a relaxing effect. The familiarity effect provides comfort to the patient.^{12,28,29} The lower stress value in this study was affected by the music produced by CCLAD device.

This study has shown that there is a significant difference in the pain value of children aged 7-12 years old between CCLAD and conventional syringe. Table 3 shows that most children experience less pain in CCLAD injection with music an adjunct to anesthesia and conventional syringe is considered to be more painful than the CCLAD. Table 4 shows that the mean score of pain value is lower in CCLAD with music as an adjunct to anesthesia (13.81) compared to conventional syringe (19.19).

Computer Controlled Local Anesthetic Delivery (CCLAD) is a painless anesthetic device. The speed of anesthetic injection into the tissue is controlled by the computer.^{13,15} CCLAD introduces the concept of pen-like handle thus it will improve tactile control and increase dexterity during the injection process. CCLAD has local anesthetics delivery through a computerized system that is slow and constant with controlled pressure based on tissue resistance. This property will increase the ability to reduce pain.^{11,30,31}

The study by Nusstein et al., Yenisey et al., Shah et al., Singh et al.¹³, and Chang et al.¹⁵ suggested that block injection on palatal region (AMSA) with CCLAD resulted in milder pain.^{13,15,32} Aggarwal et al.³¹ study revealed the measurements of pain using the Visual Analog Scale (VAS) between CCLAD and conventional syringes. The results of VAS values were lower in CCLAD, but there were no statistically significant differences.

Conventional syringes do not allow proper control of the flow rate of anesthetics, injections into dense tissues such as the palate require pressure up to 660 psi, so the control of the syringe is considered more difficult and uncomfortable.^{10,33}

Anaject II® is a CCLAD injection system with music that has been developed in Japan.¹¹ Anaject® regulates the speed of injection and slowly minimizes pain.¹⁰ Music has the effect of distraction, relaxation, familiarity, and has the ability to release endorphins.^{12,28,29}

Music affects the limbic system and autonomic nerves, creating an atmosphere of relaxation, and stimulating the secretion of endorphins β which eliminates pain neurotransmitters. The anti-pain effect is directly affected by endorphins. The distraction effect on music can distract patients so the patients are not focused on the pain.^{12,28,29}

5. Conclusion

There are differences in stress and pain values of children aged 7-12 years old between CCLAD injection with music as an adjunct to anesthesia and conventional syringe. CCLAD injection with music is less stressful and painful for children than conventional syringes.

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