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DIFFERENCES OF ONSET AND DURATION OF ACTION IN LOCAL ANESTHESIA WITH THE TUMESCENT TECHNIQUE USING LIDOCAINE AND EPINEPHRINE WITH A 1:500,000, 1:1,000,000 DILUTIONAND CONTROL

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ABSTRACT

Background: Many procedures today can be performed using the Tumescent local anesthetic technique. Several studies using this technique resulted in a clean, safe, and effective operating field, and can reduce the cost of several elective operations. Therefore, the researchers wished to investigate differences in duration and onset of action of Tumescent anesthetics during surgery and before surgery in different dilution concentration groups. **Methods:** This experimental analytical study was conducted to compare the onset and duration of local anesthetic action with the Tumescent technique using lidocaine and epinephrine with dilutions of 1:500,000, 1: 1,000,000 and controls usinglidocaine only. The subjects of this study were male or female young adults who met the inclusion criteria and exclusion criteria with the research formula obtained 10 samples in each group. Tumescent technique local anesthetic injection was performed in the hand area. Onset and duration were assessed by sensory sensation using the cotton wool test. **Results:** Based on ANOVA statistical test on the onset of action, there was no significant difference in the mean of onset in the three groups (p<0,945) and found a significant difference in the duration of work of the three groups (p<0,00). **Conclusion:** There was a significant difference in the duration of work between lidocaine-only group and dilution concentration groups (p<0,00).

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INTRODUCTION

The development of several arm and wrist surgical procedures using local anesthetic techniques is increasingly being used. Previous experience has shown that the use of local anesthetics with epinephrine is safe and, in some surgical procedures such as tendon repair or removal, allows intraoperative control of overall motion and function. Until recently, most arm surgeries were performed with a tourniquet to provide better visibility. However, the use of a tourniquet makes the patient very uncomfortable. To avoid this, surgeons have traditionally relied on anesthesiologists to provide sedation, brachial plexus block or Bier block, or general anesthesia (Lalonde *et al.*, 2016). So far, in the field of hand and finger surgery, local anesthetics containing epinephrine with the Tumescent technique have demonstrated their efficacy and safety with clinical evidence. Through retrospective studies, the very dilute concentration of epinephrine i.e. the "one-per-mile" technique has also revealed its efficacy and safety for a wide range of indications to assist in various procedures. This is advantageous for patients, hospitals, and health care insurers i.e. enormous potential for cost reduction as hand surgery can be performed without a tourniquet; thus no need for general or regional anesthesia (Gordley, 2006). Many procedures today can be performed using the Tumescent local anesthetic technique. This technique is mostly used in elective cases as the primary procedure. Epineferin has shown a vasoconstrictive effect at concentrations of 1:1,000,000, but many surgeons use concentrations of 1:100,000 to 1:400,000, which are commercially available. Research conducted by Prasetyono using the "one-per-mile" Tumescent technique has proven that this concentration produces a clean, safe, and effective operating field for various hand and upper extremity operations.

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In the absence of underlying vascular complications, epinephrine in concentrations of 1:200,000 to 1:1,000,000 has been shown to be safe when used with local anesthetics in digital blocks (Prasetyono, 2014; Prasetyono, 2016). The benefits of a conscious local anesthetic approach without a tourniquet include: (1) No sedation and no tourniquet thereby increasing patient comfort. Patients can undergo hand surgery in the same way as minor procedures at the dentist. (2) Eliminates the anesthetic/sedating component thereby reducing treatment time for minor procedures such as carpal tunnel and trigger finger surgeries. (3) During the procedure, the surgeon becomes able to view and repair sutured tendons, fixed bones, and joints because the patient can perform various active movements comfortably and cooperatively. This certainly improves tendon repair, transfer, and fixation of finger fractures (Gordley, 2016). Based on this, the investigators wished to investigate differences in the duration and onset of anesthetic action during surgery and before surgery in several concentration groups of dilutions of one per mil Tumescent containing 1:1,000,000 epinephrine and 0.2% lidocaine compared to the smaller and more frequently used concentrations, namely 1:500,000 and control with pure lidocaine. This type of research has never been done before, especially in North Sumatra, so it is very useful for further research.

MATERIALS AND METHODS

This study is an experimental analytical study with a post test controlled group design to compare the onset and duration of action of local anesthetics with the Tumescent technique using lidocaine and epinephrine with dilutions of 1:500,000, 1: 1,000,000 and the control using pure lidocaine. This research was conducted at the Division of Reconstructive and Aesthetic Plastic Surgery, Department of Surgery, USU Medical Faculty, H. Adam Malik Hospital, Medan. The subjects of this study were male or female young adults who met the inclusion criteria and exclusion criteria taken by consecutive sampling. The subjects included in the study were research subjects who agreed and signed an informed consent, research subjects had no side effects and allergic reactions to lidocaine and epinephrine and study subjects without comorbidities that could cause bias. Meanwhile, research subjects had previously received vasoconstrictive agents, study subjects had previously received antiplatelet and anticoagulant agents, study subjects with skin disease at the injection site, and study subjects with peripheral vascular disease were exclusion criteria. Because this research is experimental, then the number of samples was calculated using the Federer formula, so that the minimum number in 1 group was 9 research subjects, so the total number of subjects was 27 samples. To prevent drop out, 10% of research subjects were added, so the number of research subjects was 30 subjects. Group I was the group that was given local anesthesia with the Tumescent technique using pure lidocaine as a control. Group II was the group that was given local anesthesia with the Tumescent technique using lidocaine and epinephrine with a dilution of 1:500,000. Group III was the group that was given local anesthesia with the Tumescent technique using lidocaine and epinephrine with a dilution of 1: 1,000,000. The way of working in this study is that first randomization is carried out in grouping samples, then location marking is carried out on the volar part of the forearm in the 3x3cm injection area. Then performed asepsis and antiseptic measures at the site of action. Tumescent technique local anesthetic was injected with a 1 cc syringe and a 27G needle, previously aspirated to prevent injection into a vein. Then sensation was assessed using a cotton wool test at the start of the injection and evaluated every 10 minutes. Then calculate the onset and duration of each group. The collected data is processed and presented with statistical software. Differences in the three groups for each variable of onset and duration were analyzed by ANOVA test, if significant differences were found, it was continued by unpaired T test.

RESULTS

From the results of statistical tests, the mean onset of lidocaine in each group was 114 ± 44,272 seconds in the control group, 114 ± 44,272 seconds in group II and 120 ± 48.99 in group III. From the results of the One way ANOVA statistical test on the onset of pure lidocaine compared with the two dilution groups, there was no significant difference in the mean of onset in the three groups (p<0,945). These results showed that there was no significant difference in onset of action between patients given pure lidocaine and the dilution group. From the statistical test results, the average duration of lidocaine in each group was 132 ± 15.67 minutes in the control group, 283.5 ± 38,083 minutes in group II and 258.80 ± 66,372 in group III.

From the results of the One way ANOVA statistical test on the onset of action of pure lidocaine compared to the two dilution groups, there was a significant difference in the mean duration of the three groups (p<0,00). These results indicate that there is a significant difference in onset of action between patients given pure lidocaine and the dilution group. Table 3 shows a significant difference (mean) in the control group which was analyzed with group II, it was found that p = 0.000 (p <0.05) Table 4 showed that there is a significant difference (mean) between the control group analyzed and group III, it is obtained p = 0.000 (p <0.05).

Table 1. Differences in the onset of action of lidocaine

	Lidocaine onset (Mean ± Standard Deviation)	p value
Control Group	114 ± 44,272	
Group II	114 ± 44,272	0.945
Group III	120±48.99	

*One-Way ANOVA test

Table 2. Differences in duration of action of lidocaine

	Lidocaine duration (Mean ± Standard Deviation)	p value
Control Group	132±15.67	
Group II	283.5 ± 38.083	0.00
Group III	258.80 ± 66,372	

*One-Way ANOVA test

Table 3. Results of T-Test in the Control Group and Group II

	N	Average ± sb	Difference Mean ± sb	95% CI	*p*
Duration Pure Lidocaine	10	132±15.67	151.5 ± 38.662	123,843 – 179,157	0.000
Duration Lidocaine 1: 500,000	10	283.50 ± 66.37			

Table 4. Results of T-Test in the Control Group and Group III

	N	Average ± sb	Difference Mean ± sb	95% CI	*p*
Duration Pure Lidocaine	10	132±15.67	126.8 ± 64.04	80,983 – 172,617	0.000
Duration Lidocaine 1: 1,000,000	10	258.80 ± 66.37			

Table 5. T-Test Results in Group II and Group III

	N	Average ± sb	Difference Mean ± sb	95% CI	*p*
Duration Lidocaine 1: 500,000	10	283.50 ± 38.08	24.7±35.61	0.778 – 50.178	0.56
Duration Lidocaine 1: 1,000,000	10	258.80 ± 66.37			

DISCUSSION

Research conducted by Prasetyono using the "one-per-mile" Tumescent technique has proven that this concentration produces a clean, safe, and effective operating field for various hand and upper extremity operations. In the absence of underlying vascular complications, epinephrine in concentrations of 1:200,000 to 1:1,000,000 has been shown to be safe when used with local anesthetics in digital blocks (Prasetyono, 2014). With regard to the onset and duration of action (DOA) of lidocaine in Tumescent solution, only limited data are available. According to Keramidas and Rodopoulou, the onset of action (OOA) of 2% lidocaine was 1.3 minutes (Keramidas *et al.*, 2007). In the study, the onset of action of pure lidocaine and group II was the same, namely 114.5 ± 44.27 seconds and in group I the onset of action was slightly longer at 120 ± 48.99 seconds. These results are in line with research byPrasetyo et al, obtained the value of onset and duration of the use of Tumescent anesthesia with a dilution of 1: 1,000,000. This study compared the onset and duration of anesthetic action using 2% lidocaine and Tumescent anesthesia with a 1:1,000,000 dilution. In the anesthetic group with 2% lidocaine, the mean onset was 1 minute, ranging from 1-6 minutes. While in Tumescent anesthesia using a dilution of 1: 1,000,000, onset is more variable with an average of 5 minutes (range 1-9 minutes) (Prasetyono, 2016).

The results of the analysis using the test *one way* ANOVA on The onset of action of pure lidocaine compared with the dilution group obtained a p-value of 0.945 (p>0.05). These results showed that there was no significant difference in onset of action between patients given pure lidocaine and the dilution group. This is also directly proportional to the study by Prasetyo et al where the two groups analyzed were 2% lidocaine and with a dilution of 1: 1,000,000 there was no statistically significant difference. (P = 0.04; Wilcoxon signed-rank test).[4] This means that the use of pure lidocaine or diluted lidocaine has the same onset of action. This is advantageous for patients, hospitals, and health care insurers i.e. enormous potential for cost reduction with the same effect. In this study it was found that there was a significant difference in the average duration of the three groups. This means that there is a significant difference in duration between patients who were given pure lidocaine and the dilution groups of 1: 500,000 and 1: 1,000,000 (p<0.00). The duration of action of lidocaine in each study group was 132 ± 15.67 minutes in the control group, 283.5 ± 38,083 minutes in group II and 258.80 ± 66,372 in group III. This is in line with the study by Thomson and Lalonde which revealed that the duration of action of pure 2% lidocaine with epinephrine and 2% lidocaine with a dilution of 1:100,000 plus epinephrine was 4.9 hours and 10.4 hours, respectively (Thomson, 2006). On the duration of action of lidocaine, significant results were obtained in data analysis, then continued with significant group testing. The Independent T-Test test showed a significant (mean) change between the control group and group II and between the control group and group III with p<0.00 in each group. The duration of action of lidocaine with dilution is longer than that of pure lidocaine. Another study that is also in line with this study is a study by Prasetyono et al, 2016 which showed that the duration of action of the 2% lidocaine group was 99.67 minutes, shorter than the duration of action of the Tumescent anesthetic group with a dilution of 1: 1,000,000. In that group, it was found that the duration was longer, namely 186 minutes. This is statistically significant (P < 0.001; paired t-test) (Prasetyono, 2016). Epinephrine or adrenaline is a very important component in anesthesia *tumescent*, which is 1:1000000. This substance is a good hemostasis, can inhibit the absorption of lidocaine, and prolong the anesthetic effect. With the Tumescent technique, an anesthetic effect is obtained for 10-18 hours (Trisnarizki *et al.*, 2018). The use of sensory examination modalities in this study used a simple test, namely: *cotton wool.*The same cotton wool was used in each subject and performed by the same examiner. Examination of cotton wool has several advantages, namely fast, cheap and easy to do so it is suitable to be carried out in this study (Trisnarizki, 2018; Vinycomb, 2014). This study was conducted on a healthy sample so that it becomes a weakness in this study. And further research needs to be done regarding the analysis of costs, side effects and complications in each group

CONCLUSION

Based on test analysisone wayANOVA there was a significant difference in duration of action between subjects given pure lidocaine and the dilution group, p value = 0.00(p<0.05). However, there was no significant difference in the onset of action between subjects given pure lidocaine and the dilution group, p value = 0.945 (p>0.05).

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