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COMPARISON OF HYDRODISSECTION INJECTION THERAPY USING ULTRASONOGRAPHIC AS GUIDES BETWEEN TRIAMCINOLONE ACETONIDE AND 5% DEXTROSE IN CARPAL TUNNEL SYNDROME

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Abstract

Background: Carpal Tunnel Syndrome (CTS) is a symptomatic compression neuropathy of the median nerve characterized by increased pressure in the carpal tunnel and decreased nerve function due to compression of the median nerve in the carpal tunnel. The purpose of the hydrodissection injection method in CTS is to separate the soft tissue adhesions that cause nerve compression and this method are known for being minimally invasive, fast healing, and easy to apply. Local injection of triamcinolone acetonide (TCA) is often used as therapy for CTS because it stabilizes the sodium channels and reduces abnormal stimulatio, thus it relieved the pain. 5% dextrose injection (D5W) is also widely used as therapy of CTS because it is harmless to nerves and may reduce neurogenic inflammation through inhibition of capsaicin-sensitive receptors.
Aim: To compare the effectivity of hydrodissection injection therapy using ultrasound guidance with triamcinolone acetonide and 5% dextrose in CTS.
Methods: This study recruited 30 participants who diagnosed with CTS and met the inclusion criteria. Participants were divided into two treatment groups, the first group (n=15) was given 1ml TCA injection and 1 ml lidocaine 2%, while the second group (n=15) was given 5% 5 ml Dextrose injection. The parameters measured in this study were NRS, FSS, and SSS value before injection and 4 weeks after injection of the agent. We compared these parameters at week four after injection between the TCA group and the D5W group.
Results: NRS values before and 4 weeks after TCA injection (sig 0.001; p <0.05), FSS values (sig 0.020; p <0.05), and SSS values (sig 0.001; p <0.05). NRS before and 4 weeks after injection of D5W (sig 0.002; p <0.05), FSS (sig 0.001; p <0.05), and SSS (sig 0.000; p <0.05). Comparison between TCA injection and D5W injection at 4 weeks after the injection showed that the results was significantly different on NRS (sig 0.806; p> 0.05) for FSS (sig 0.512; p> 0.05) and SSS (sig 0.293; p> 0.05).
Conclusion: There is a significant difference in NRS, FSS and SSS values at 4 weeks after hydrodissection injection, using either TCA or D5W. TCA hydrodissection injection compared to D5W hydrodissection injection was equally effective in improving NRS, FSS and SSS after 4 weeks of injection.

Keyword : BCTQ, Carpal Tunnel Syndrome, D5W, Hydrodissection, TCA, NRS

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is one of the most common types of peripheral neuropathy and is a symptomatic compression neuropathy of the median nerve characterized by increased pressure in the carpal tunnel and decreased nerve function. This syndrome is a collection of symptoms characterized by pain, paresthesia of the wrist to the palms of the lateral sides of the fingers I to IV fingers with nocturnal exacerbations due to compression of the median nerve in the carpal tunnel under the flexor retinaculum (2,5).

Epidemiologically, this syndrome is more common in women, twice as many as in men and 76% of cases occur at the age of 40-60 years. It occurs more frequently at the climacteric period, during or immediately after pregnancy, and in obese patients. In CTS the symptoms is more common in the dominant hand, but it also often may occur on both sides (1).

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Various risk factors of this syndrome include increased pressure in the tunnels due to a change in the position of the wrist or external pressure which results in increased pressure leading to clamping, shifting of nerves and nerve injury.

Genetic factors played by the alpha-1 chain collagen type V gene, which is the basic structure of the tendon, is closely related to the occurrence of CTS. Metabolic diseases such as diabetes, thyroid dysfunction, rheumatoid arthritis, and obesity are also thought to increase the risk factors for CTS. According to Werner et al. that patients with a Body Mass Index (BMI)> 29 had a 2.5 times greater risk of developing CTS than those with a BMI <20.6 Occupational risk factors have an important role with the risk of developing CTS. Repetitive hand activity is generally suspected as the cause for this syndrome (6,7).

The pathophysiology of CTS is not fully understood, but is mostly associated with mechanical injury, ischemia, ectopic impulses, demyelination, tendonitis, and increased pressure in the carpal tunnel. The pathology of chronic nerve compression is due to damage to the blood-nerve barrier, followed by endoneurial and sub-perineural edema and thickening and fibrosis of the perineurium and epineurium connective tissue. Fibrosis organized in the sub-perineural space is associated with repetitive motion and traction. Furthermore, there is demyelination of segmental nerve fibers, especially large nerve fibers. In the advanced stages of progressive compression, severe diffuse demyelination and injury occurs to both myelinated and nonmyelinated nerves leading to wallerian degeneration. Sub-perineural edema, inflammation, and fibrin deposit formation occur within a few hours and fibrous tissue proliferation occurs within a few days, until fibrosis occurs within twenty-eight days (6).

Various types of CTS therapy methods have been introduced, starting with non-surgical methods (physiotherapy, psychological approaches, pharmacotherapy, injection) to surgical (surgery) approach (8). The hydrodissection injection method has the advantage of being a minimally invasive action, fast healing, and easy to treat or applying the technique (12). The aim of this technique is to isolate the soft tissue adhesions that can cause nerve compression.19,20 There is currently growing evidence that the use of sonographic guided needles largely results in significant improvements in accuracy and the results compared to traditional palpation guidance methods. The use of sonography has been utilized successfully for CTS injection with very good results (11).

Triamcinolone acetonide (TCA) is a corticosteroid that is often used as therapy for CTS. The combination of procaine and triamcinolone injection can theoretically stabilize sodium channels and reduce abnormal stimulation so as to provide pain relief (34,35)

Injection therapy with 5% dextrose solution (D5W) has been widely used. This solution has an osmolality similar to normal saline. Human and animal studies have found that D5W is harmless to nerves. Dextrose can reduce neurogenic inflammation through inhibition of capsaicin-sensitive receptors (e.g., transient potential vanilloid-1 receptors) to inhibit the secretion of both substance-P (SP) and calcitonin gene-related peptide (CGRP) which are known to induce pain and inflammation of nerves and / or the surrounding tissues (41).

Several questionnaires can be used to assess the condition of CTS, including the Carpal Tunnel Questionnaire (CTQ) / Boston Carpal Tunnel Questionnaire (BCTQ), Michigan Hand Questionnaire (MHQ) and the Disability of Arm, Shoulder, or Hand Questionnaire (DASH). BCTQ is more sensitive and specific than other assessment scoring (6).

METHOD

This research used quasi experimental research design. The study population was all patients with carpal tunnel syndrome (CTS) in the outpatient neurological clinic of dr. Saiful Anwar Public Hospital Malang during April 2020 - September 2020. This research used simple random sampling technique with the rule of thumb formula where the required sample size is 30 samples, with a minimum number of 15 samples per treatment group.

The inclusion criteria in this study included patients with complaints of neuropathic pain in the area innervated by n. median, the pain felt at least 1 month, Numeric Rating Scale (NRS) ≥ 4, positive tinnel sign and phalen test, already did the ENMG electrophysiological examination with the result of mild to moderate CTS and already signing the informed consent. The exclusion criteria in this study included age <18 years or> 80 years, there was a history of polyneuropathy / brachial plexopathy, the presence of thenar muscle atrophy, infection at the injection site, a history of surgery for previous CTS treatment, presence of fractures or deformities in the wrist, never received oral pharmacotherapy.

The independent variable in this study was hydrodissection injection using ultrasound guidance with TCA and D5W in carpal tunnel syndrome (CTS) patients. While the dependent variable in this study includes the degree of pain based on the results of the numeric rating scale (NRS) and the Boston carpal tunnel questionnaire (BCTQ) which consists of the functional status scale (FSS) and Symptom Severity Scale (SSS) components.

The questionnaire validity test was conducted using Pearson correlation analysis. It is said to be valid if the p value <α (0.05). The results of the validity test showed that the p value for all question items is 0.000 <0.05, it can be concluded that the research instrument (questionnaire) is valid. Thus, these instruments can be used for this study.

The questionnaire reliability test was conducted using Cronbach's alpha value. A measuring instrument is said to be good if it has a Cronbach alpha value> 0.60. The results of the reliability test showed that the Cronbach alpha value for the symptom severity scale (SSS) was 0.939> 0.60, it can be concluded that the research instrument (questionnaire) was reliable. Cronbach's alpha value for the functional status scale (FSS) is 0.944> 0.60, it can also be concluded that the research instrument (questionnaire) is reliable. These instruments can be used for this study.

The research procedure was carried out by conducting a brief history taking to obtain the information about the type and duration of neuropathy complaints, onset and the duration of CTS, degree of pain and triggering factors, evaluation of pain

scales with the NRS scale, conducting a provocative examination of Phalen's test and tinnel's sign, evaluating the results of ENMG examination studies and identification of exclusion criteria. Furthermore, the evaluation is carried out using the reference NRS and BCTQ forms, then recording is carried out. Hydrodissection injection using ultrasound guidance by a specialist using two treatments in two different groups, namely:

a. Group 1: lidocaine 2% 1 cc and TCA 10 mg / mL 1 cc in a 3 cc syringe and 25 g needle
b. Group 2: 5 cc of 5% dextrose in a 5 cc syringe and a 25 g needle. (3 cc below the flexor retinaculum tendon, 2 cc in the inferior median nerve)

The injection is performed using an ultrasound-guided ulnar hydrodissection technique. The total time required to administer one treatment to a patient is 30 minutes. Furthermore, a 4-week reevaluation was carried out to assess the NRS and BCTQ post-treatment. For monitoring methods, patients are asked to report the condition by visiting the clinic or by telephone if the patient is unable to do so. All examinations are carried out by trained personnel, the results of all examinations are recorded and documented for further analysis.

The clinical profile of the research sample will be analyzed descriptively and displayed in a frequency table and statistical analysis will be carried out using statistic software SPSS version21.0. To compare NRS, FSS and SSS in patients with TCA and D5W injection, an independent t test was used if the data passed the normality test and the Mann Whitney test if it did not pass the normality test. Meanwhile, to compare the NRS, FSS and SSS in patients before and after injection we used Wilcoxon statistical analysis if the data didn't pass the normality test. This study has conducted an ethical feasibility test and already approved by the Health Research Ethics Committee of the Regional General Hospital dr. Saiful Anwar Malang in accordance with the Ethical Approval / Information Passing Ethical Review No. 400/132 / K3 / 302/2020.

RESULT

Characteristics of research Data

The purpose of this study was to determine the comparison of the effectivity of hydrodissection injection therapy using ultrasound guidance between triamcinolone acetonide and dextrose 5% in patients with carpal tunnel syndrome at the Outpatient Clinic of the dr. Saiful Anwar Public Hospital Malang. The total sample obtained in this study were 30 patients; 15 patients in the hydrodissection injection group with TCA and 15 patients in the D5W injection group. The characteristics of the research data are shown in table 1.

Table 1 showed the most average age ranges from 41 to 60 years with 18 patients (60%). Most of the patient was female with 27 patients (90%). The most dominant hand was the right hand in 21 patients (70%) followed by the left hand in 9 patients (30%). Most occupations are dominated by housewives as many as 9 patients (30%). Patients come with the most numeric rating scale (NRS) pain in severe category with 24 patients (80%).

Differences of NRS, FSS and SSS Values in Patients with TCA Injection

The difference in the results of the NRS, FSS and SSS assesment before and after the TCA injection was carried out by t tests.

Previously, the normality test was carried out. If the normality test is fulfilled ($p > 0.05$), a different test is performed with the dependent t test. If the normality test is not fulfilled ($p < 0.05$), a different test is performed with the Wilcoxon test. The results of the normality test are presented in Table 2.

Table 1. Characteristics of research data

Variables	Frequency (*n*)	Percentage (%)
Age		
18 – 40 years old	9	30.00
41 – 60 years old	18	60.00
> 60 years old	3	10.00
Gender		
Female	27	90.00
Male	3	10.00
Hand		
Left	9	30.00
Right	21	70.00
Occupation		
Cigarette roller	3	10.00
Nurse	1	3.33
Housemaid	1	3.33
Teacher	3	10.00
Private sector employees	3	10.00
Cigarette factory employees	2	6.67
Baker	1	3.33
Housewife	9	30.00
Retiree	1	3.33
Door-to-door salesman	1	3.33
Secretary	1	3.33
Doctor	1	3.33
Rujak seller	1	3.33
Office employees	1	3.33
Laundromat employees	1	3.33
***Numeric Rating Scale* (NRS)**		
None (0)	0	0
Mild (1-3)	0	0
Moderate (4-6)	6	20

Table 2. Normality test results before and after TCA injection

Variables	P value	Conclusion
Before Injection		
NRS	0.037	The data are not normally distributed
FSS	0.027	The data are not normally distributed
SSS	0.772	The data are normally distributed
After Injection		
NRS	0.437	The data are normally distributed
FSS	0.021	The data are not normally distributed
SSS	0.929	The data are normally distributed

Note: NRS=numeric pain rating scale; FSS=functional status scale; SSS=symptom severity scale

Based on table 2, the use of the difference test between before and after the TCA injection on the SSS variable uses the dependent t test, the FSS variable uses the Wilcoxon test and NRS uses the Wilcoxon test.

Table 3 showed the mean NRS of patients before TCA injection was 7.27 ± 0.96 and after TCA injection was 5.00 ± 2.20. The results of the Wilcoxon test showed that the median NRS of patients before and after TCA injection was significantly different (p <0.05), so it can be concluded that TCA injection reduces NRS. Meanwhile, the mean FSS of patients before TCA injection was 2.27 ± 1.01 and after TCA injection was 2.13 ± 1.02. The results of the Wilcoxon test showed that the median FSS of patients before and after TCA injection was significantly different (p <0.05), so it can be concluded that TCA injection can reduce FSS. The mean SSS of patients before TCA injection was 2.84 ± 0.93 and after TCA injection was 2.60 ± 0.87. The results of the dependent t test showed that the mean SSS value of patients before and after TCA injection was significantly different (p <0.05), so it can be concluded that the TCA injection can reduce SSS.

Differences of NRS, FSS and SSS Values in Patients with D5W Injection

The difference in the results of the NRS, FSS and SSS before and after the D5W injection was carried out by difference test. Previously, the normality test was carried out. If the normality test is fulfilled (p> 0.05), a different test is performed with the dependent t test. If the normality test is not fulfilled (p <0.05), a different test is performed with the Wilcoxon test. The results of the normality test are presented in table 4.

Based on table 4, the use of the difference test between before and after D5W injection on the SSS variable uses the dependent t test, the SSS variable uses the Wilcoxon test and NRS uses the Wilcoxon test.

Table 5 showed the mean NRS of patients before D5W injection of 7.07 ± 0.70 and after D5W injection of 5.33 ± 0.72. The results of the Wilcoxon test showed that the median NRS of the patients before and after D5W injection was significantly different (p <0.05), so it can be concluded that D5W injection can reduce NRS. Meanwhile, the mean FSS of patients before D5W injection was 1.99 ± 0.52 and after D5W injection was 1.72 ± 0.51, the results of the Wilcoxon test showed that the median FSS of patients before and after D5W injection was significantly different (p <0.05), so it can be concluded that D5W injection reduces FSS value. Meanwhile, the mean SSS of patients before D5W injection was 2.74 ± 0.55 and after D5W injection was 2.33 ± 0.38. The results of the dependent t test showed that the mean SSS of the patients before and after D5W injection was significantly different (p <0.05), so it can be concluded that D5W injection reduces SSS.

Differences of NRS, FSS and SSS values in Patient with TCA and D5W Patients After 4 Weeks

The comparison of the results of examining the NRS, FSS and SSS values on the hydrodissection injection of TCA and D5W is shown in Table 6. Before the difference test was carried out, the normality test was performed. If the normality test is fulfilled (p> 0.05), a different test is performed with an independent t test. If the normality test is not fulfilled (p <0.05), a different test is performed using the Mann Whitney test. The results of the normality test are presented in table 2 and table 4.

Based on tables 3 and 5 the use of the SSS difference test between TCA injection and D5W injection before injection uses the independent t test. The FSS and NRS difference test between TCA injection and D5W injection before injection used the Mann Whitney test.

Based on Tables 5.5 and 5.6, the use of the SSS difference test between TCA injection and D5W injection after injection uses the independent t test. The FSS and NRS difference test between TCA injection and D5W injection after injection used the Mann Whitney test.

Table 3. Differences in the NRS, FSS and SSS values of patients with TCA Injection

Variables	Test	Before Mean ±SD (Median)	After Mean ±SD (Median)	P value
NRS	Wilcoxon	7.27±0.96 (7)	5.00±2.20 (5)	0.001
FSS	Wilcoxon	2.27±1.01 (2)	2.13±1.02 (1.75)	0.020*
SSS	t dependent	2.84±0.93 (2.73)	2.60±0.87 (2.45)	0.001*

Note: NRS=numeric pain rating scale; FSS=functional status scale; SSS=symptom severity scale; *=significant < a(=0,05)

Table 4. Normality test results before and after D5W injection

Variables	P value	Conclusion
Before Injection		
NRS	0.006	The data are not normally distributed
FSS	0.039	The data are not normally distributed
SSS	0.813	The data are not normally distributed
After Injection		
NRS	0.002	The data are not normally distributed
FSS	0.003	The data are not normally distributed
SSS	0.903	The data are not normally distributed

Note: NRS=numeric pain rating scale; FSS=functional status scale; SSS=symptom severity scale

Table 5. Differences in the NRS, FSS and SSS values of patients with D5W injection

Variables	Test	Before mean±SD (Median)	After mean±SD (Median)	P value
NRS	Wilcoxon	7.07±0.7 (7)	5.33±0.7 (5)	0.002*
FSS	Wilcoxon	1.99±0.5 (1.88)	1.72±0.5 (1.5)	0.001*
SSS	t dependent	2.74±0.5 (2.73)	2.33±0.3 (2.36)	0.000*

Note: NRS=numeric pain rating scale; FSS=functional status scale; SSS=symptom severity scale; *=signifikan < a(=0,05)

According to table 6, the analysis using the Mann Whitney test showed the mean NRS of the patient before D5W injection of 7 and the TCA injection of 7. The difference in NRS between patients who were injected with D5W and TCA was not significant (p value 0.683; p> 0.05) and it can be concluded that the NRS value patients before injection of D5W and TCA were the same. The mean NRS of patients after D5W injection was 5 and TCA injection was 5. The difference in NRS between patients injected with D5W and TCA was not significant (p value 0.806; p> 0.05), it can be concluded that both injections were equally effective in reducing NRS values.

The FSS analysis using the Mann Whitney test according to table 6 showed the mean FSS value of the patient before D5W injection of 1.88 and the TCA injection of 2.

The difference in FSS between patients who were injected with D5W and TCA was not significant (p value 0.624; p> 0.05) so that it can be concluded that the value The FSS of the patient before D5W and TCA injection was the same. Meanwhile, the mean FSS of the patient after D5W injection was 1.5 and TCA injection was 1.75, so that the difference in FSS between patients injected with D5W and TCA was not significant (p value 0.512; p> 0.05), and it can conclude that both injections were equally effective in lowering FSS value.

Table 6. Differences in the NRS, FSS and SSS values of patients with TCA and D5W injection

Variables	Test	D5W Injection mean±SD (Median)	TCA Injection mean±SD (Median)	P value
Before Injection				
NRS	Mann Whitney	7.07±0.70 (7)	7.27±0.96 (7)	0.683
FSS	Mann Whitney	1.99±0.52 (1.88)	2.27±1.01 (2)	0.624
SSS	t independent	2.74±0.55 (2.73)	2.84±0.93 (2.73)	0.699
After Injection				
NRS	Mann Whitney	5.33±0.72 (5)	5.00±2.20 (5)	0.806
FSS	Mann Whitney	1.72±0.51 (1.5)	2.13±1.02 (1.75)	0.512
SSS	t independent	2.33±0.38 (2.36)	2.60±0.87 (2.45)	0.293

Note: NS=normal saline; TCA=triamcinolone acetonide; NRS=numeric pain rating scale; FSS=functional status scale; SSS=symptom severity scale; significant < a(=0,05)

The mean SSS according to table 6 with independent t test shows that patients before D5W injection were 2.74 ± 0.55 and TCA injection was 2.84 ± 0.93, the difference in SSS between patients before D5W and TCA injection was not significant (p value 0.699; p> 0.05), it can be concluded that the SSS values of the patients before injection of D5W and TCA are the same. The mean SSS of patients after D5W injection was 2.33 ± 0.38 and TCA injection was 2.84 ± 0.93. The SSS difference between patients after D5W and TCA injection was not significant (p value 0.293; p> 0.05), it can be concluded that the two injections were equally effective in reducing SSS values.

DISCUSSION

Characteristics of Research Data

This research was conducted at the outpatient clinic of neurology department in dr. Saiful Anwar Public Hospital Malang. In the study sampling, the total sample in this study was 30 patients, consisting of 15 patients in the hydrodissection injection group with triamcinolone acetonide (TCA) and 15 patients in the 5% dextrose injection group (D5W).

The COVID-19 pandemic era has led to a decrease in the number of patient visits who come to the neurology departmeny outpatient clinic of dr. Saiful Anwar Public Hospital Malang, and it has an impact on the minimum total sample obtained in each group. However, the overall sample size in this study was sufficient for the minimum sample size required, which was 30 patients.

Age

The overall average age in this study was mostly in the age range 41 - 60 years, which was 60% of the total research subjects. The second largest age range is in the range 18-40 years or equivalent to 30% of the total study subjects, and age> 60 years is 10% of the total sample obtained in this study.

This result is in line with the existing theory, that in terms of epidemiological data, the incidence of CTS is indeed more common in adulthood, or around 40 to 60 years. The incidence of CTS is generally more than 10% of the adult population and based on the results of a study in America in 2003, they found that CTS was as much as 3% of the adult population. As many as 57% of cases occurred at the age of 40 - 60 years and 76% of cases occurred at the age of 40 - 70 years (1,16,18).

Age factor does play a strong role in the incidence of CTS.In elderly, there are changes in the collagen in the flexor of the retinaculum, so that its elasticity is reduced. The carpal tunnel is indeed limited by hard walls, so if there is a pressure / tension caused by a system, a chain reaction will occur, namely compression of the veins, which causes hyperemia, then resistance, causing a slowing of blood flow. in epineurium and fasicles (6,18).

Gender

Based on the results of the study, it was shown that the most gender who experienced CTS cases were women, namely 90% of the total research subjects. While men were only 10% of the total research subjects.

This is in accordance with the theory which explains that the incidence of CTS is twice as common in women as in men.1,16 Women are known to have a two to three times greater risk than men, and this risk increases at the age before menopause. Hormonal changes played a role in this. It has been reported that there were alpha estrogen receptors on the transverse carpal ligament and flexor tenosinovium, and estrogen also regulates collagen synthesis and fibroblast proliferation. When the collagen composition changes, the tissue changes too. This increases the risk of injury to tearing of the tenosynovial tissue. In addition, women have smaller hands, so the carpal tunnel is also smaller, this means that if there is increased pressure in the carpal tunnel, it will further increase the risk of developing Carpal Tunnel Syndrome (CTS) (6).

Affected Hand

Based on the results of this study the right hand is the hand that affected by CTS more frequently than the left hand. In these results, it can be seen that as many as 70% of the total research subjects experienced CTS on their right hand, and

only 30% of the total study subjects experienced CTS on their left hand.

Right hand is more often affected by this disorder because of the relatively frequent use of the right hand as the dominant hand to do something. In general, right-handed people will use their right hand in everyday life and repeatedly. Where repetitive activity on one hand is generally suspected as the cause of this syndrome. Repetitive flexion and extension movements of the wrist will cause increased pressure in the carpal tunnel. One study found a strong association between repetitive wrist movements and the incidence of CTS (6,7).

Occupation

Various types of work were found in the study population. From the results of the study, we found that the most common occupation is a housewife, which is 30% of the total subjects. Occupation as cigarette roller, teachers, and the private sector employee are in the next rank with 10% each of the total research subjects. Cigarette factory employees are 6.67% and the rest profession are as nurses, domestic helpers, baker, retirees, door-to-door salesman, secretaries, doctors, rujak seller, office employees, and laundromat employees as much as 3.33% of the total subjects.

Occupation is a risk factor that has an important relationship with the incidence of CTS. 6,7 In the research result, it was stated that the occupation that mostly occurred in CTS was housewives. Housewife will often do household chores, such as washing clothes and sweeping. In a literature, it is stated that usually the dominant work using the wrist will have a great potential for CTS. In the case of CTS, where the patient, due to his work always using the wrist, allows the median nerve entrapment which causes mechanosensitive-hot-spots, which are very sensitive to mechanical stimulation (mechanical hyperalgesia) and dysesthesia due to ectopic discharge of Aβ nerve fibers. and pain due to ectopic discharge of C. mechanosensitive-hot-spots which are very sensitive to mechanical stimuli, so that with a little tapping in the area will cause pain (Tinel sign) (16,19).

In addition, the results of this study are also in line with other studies which found that jobs such as washing clothes and sweeping can increase symptoms in CTS patients. Some researchers suggest that there are six important risk factors for a job to cause CTS. These risk factors include repetitive movements, high speed movements, uncomfortable joint positions, direct pressure on the wrist, vibration, and posture of the wrist that is maintained for a long time (7).

Differences of NRS, FSS, and SSS values in Patients with TCA Injection

In this study, the NRS, FSS and SSS values were examined before and after the TCA injection. The NRS, FSS and SSS measurement are to date non-invasive measurement tools used to assess the degree of pain scale improvement and symptom improvement which has been demonstrated in various studies.

Patients had the highest NRS score with severe category 80% and moderate category as much as 20%. There were no patients who presented with none and mild NRS values.

Furthermore, in table 3, the mean SSS results of patients before TCA injection were 2.84 ± 0.93 and after TCA injection were 2.60 ± 0.87. This result has a statistically significant difference (sig 0.001, $p < 0.05$). The mean FSS value of patients before TCA injection was 2.27 ± 1.01 and after TCA injection was 2.13 ± 1.02, which is also a statistically significant difference (sig 0.020, $p < 0.05$). Finally, the mean NRS of patients before TCA injection was 7.27 ± 0.96 and after TCA injection was 5.00 ± 2.20, which also showed a significant difference in the SSS values of patients before and after TCA injection (sig 0.001, $p < 0.05$). Although not many, TCA is known to be a type of corticosteroid that is often used as therapy for CTS. Local corticosteroid injection is considered to be the fastest and most effective method of improving the symptoms that occur in CTS. There are several types of corticosteroids that can be used, such as hydrocortisone, dexamethasone, methylprednisolone, and triamcinolone acetonide, but there is no objective standard that can explain the most ideal drug. The combination of procaine and triamcinolone injections is known to stabilize sodium channels and reduce abnormal stimulation so as to relieve pain (9,10,34,35).

In a study conducted by Karadas et al. where 22 CTS patients were injected with 40 mg triamcinolone acetonide and 4 ml procaine HCl, followed by two procaine injections alone a week, for two weeks. EMG was performed at baseline and 2 months after treatment. There were good results on the VAS, FSS, SSS and median nerve anatomy ultrasound values. Statistically all patients showed two-month improvement in BTCQ, VAS, and median nerve ultrasound scores (6).

Differences of NRS, FSS, and SSS Values in Patients with D5W Injection

In this study, the NRS, FSS and SSS values were examined before and after D5W injection. In table 5, we can see the mean SSS value of patients before and after D5W injection, which is 2.74 ± 0.55 before injection and 2.33 ± 0.38 after D5W injection. In this table we can also know that there is a significant difference between the mean SSS of patients before and after D5W injection (sig 0.000, $p < 0.05$). Furthermore, the mean FSS of patients before and after D5W injection was 1.99 ± 0.52 and 1.72 ± 0.5, thus it means that it has a statistically significant difference (sig 0.001, $p < 0.05$). Finally, the mean NRS value of patients before D5W injection was 7.07 ± 0.70 and after D5W injection was 5.33 ± 0.72, which is also a statistically significant different (sig 0.002, $p < 0.05$).

It is known that injection therapy using 5% dextrose solution (D5W) has been widely used. This solution has an osmolality similar to normal saline. Human and animal studies have found that D5W solution is harmless to nerves. A prospective, randomized, double-blind placebo-controlled study found that ultrasound-guided perineural injection using 5% dextrose (D5W) in electrophysiologically mild to moderate neuropathy patients in the wrist provided significant pain relief and disability reduction, better electrophysiological response, and decreased cross-sectional area of the median nerve using ultrasonography. Dextrose is known to reduce neurogenic inflammation through inhibition of capsaicin-sensitive receptors (eg, transient potential vanilloid-1 receptors) to inhibit the secretion of both substance-P and calcitonin gene-related peptide which is known to induce pain and swelling of the nerves and / or surrounding tissue (16,17, 41).

Differences of NRS, FSS, and SSS Values in Patients with TCA and D5W Injection after 4 weeks

The results of the study using the Mann Whitney test portrayed in table 6 showed that the difference in NRS between patients who were injected with D5W and TCA was not significant (p value 0.683; p> 0.05), it can be concluded that the NRS value of the patient before being injected with D5W and TCA was similar. Meanwhile, the mean NRS of patients after D5W injection and TCA injection was not significant (p value 0.806; p> 0.05), and it can be concluded that both injections were equally effective in reducing NRS values.

In table 6, the Mann Whitney test showed the mean FSS of the patient before the D5W injection was 1.88 and the TCA injection was 2. The difference in FSS between patients who were injected with D5W and TCA was not significant (p value 0.624; p> 0.05), so it can be concluded that the FSS value patients before injection of D5W and TCA were the same. The median FSS value of patients after D5W injection was 1.5 and TCA injection was 1.75, the difference in FSS between patients injected with D5W and TCA was not significant (p value 0.512; p> 0.05), it can be concluded that the two injections were equally effective in reducing FSS values.

Table 6 showed that the mean SSS of patients before D5W injection was 2.74 ± 0.55 and TCA injection was 2.84 ± 0.93, the difference in SSS between patients before D5W and TCA injection was not significant (p value 0.699; p> 0.05), it can be concluded that the the patient's SSS value before injection of D5W and TCA were the same. Meanwhile, the mean SSS value of patients after D5W injection was 2.33 ± 0.38 and TCA injection was 2.84 ± 0.93. The SSS difference between patients after D5W and TCA injection was not significant (p value 0.293; p> 0.05), it can be concluded that the two injections were equally effective in reducing SSS values.

The results of the research above are different from a study by Yung-Tsan Wu, et al. In 2018, they conducted a study by carrying out 5% dextrose injection with triamcinolone on 54 samples with mild-moderate CTS which were evaluated for a period of 1 month, 3 months, 4 months and 6 months post injection. The results of this study indicate that the D5W injection group significantly reduced pain and improved disability in evaluations 4 to 6 months after injection compared to triamcinolone injection.40 This difference could be caused by the evaluation of the results of the study which carried out at the evaluation 1 month after injection and the study sample was mild to moderate CTS patients. While considering the side effects of triamcinolone, the researchers suggest that D5W could be a better choice of perineural injection solution for mild to moderate CTS patients. More specifically, in another study, it was stated that D5W injection could suppress neurogenic inflammation by inhibiting the transient receptor potential vanilloid receptor-1 (TRPV1). This condition later plays a role in inhibiting neurotransmitters, including CGRP and substance P and inhibiting neurogenic inflammation. Substance P and CGRP are degenerative neuropeptides that cause pain. These two neuropeptides play a role in the change / transition process of acute pain to chronic pain in CTS. The production and release of these two neuropeptides by activated C fibers is known as neurogenic inflammation. Leukocytes do not play a role in the occurrence of this inflammation (18,39,40).

CONCLUSION

In this study, there were significant differences in the NRS, FSS and SSS parameters before injection and 4 weeks after hydrodissection injection with TCA and D5W. TCA hydrodissection injection compared to D5W hydrodissection injection was equally effective in improving NRS, FSS and SSS parameters after 4 weeks of injection in CTS patients at Outpatient Clinic of Neurology Departmen in dr. Saiful Anwar Public Hospital Malang.

The authors suggests to increase the number of samples to reduce confounding factors that can affect the results of the study, lengthen the evaluation period, for example evaluated at 3 months, 6 months, and 12 months after injection to determine long-term effects, record and analyzing confounding factors that can affect the results of research such as drugs that have been and are still being consumed by patients before and after treatment, as well as analyzing side effects that may arise from the injection treatment.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this study.

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