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Case Report

Prolotherapy Perineural Injection In Carpal Tunnel Syndrome With Bifid Median Nerve: A Case Report

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ABSTRACT

Background: Carpal tunnel syndrome (CTS) is a common neuropathy condition caused by entrapment of the median nerve. Perineural injection therapy with 5% dextrose or prolotherapy becoming a common method for treating carpal tunnel syndrome. Although it is effective, some anatomical variaton of the median nerve could effect the outcome of the prolotherapy in CTS.
Case Report: A 43-year-old woman suffered from diurnal, nocturnal numbness and paraesthesia of the first, second , third and radial surface in the fourth finger of the right hand. She also complained pain in the same area with the VAS score of 8, and muscle weakness. Physical examination showed positive Tinel's sign, Phalen's sign and Durkan's compression test. The Boston questionnare score showed a symptom average of 3.27 and a difficulty average of 3.25. USG examination showed that the patient had a bifid median nerve anatomy variaton.
Discussion: Variation of median nerve branches has been reported as one of the prevalence of median nerve entraptment. In this case, a bifid median nerve variation was found through the USG imaging. Prolotherapy has been reported to be an effective method to treat carpal tunnel syndrome. But the bifid median nerve could affect the effectiveness of prolotherapy injection.
Conclusion: In the case of a bifid median nerve, it is necessary to modify the injection technique so it would be more able to reach the whole of the bifid median nerve.

Keywords: Carpal tunnel syndrome; Prolotherapy; Bifid median nerve ; Human and medicine

INTRODUCTION

Carpal tunnel syndrome (CTS) is a common entrapment neuropathy condition of the median nerve (MN), it causes pain, paresthesia and tingling of the hand and often needs a surgical release.[1,2] CTS affects approximately 3% of the general adult population.[3]

The mangement of CTS depends on its severity. In minor circumstance, conventional treatment is more recommended.[1,4] This conventional treatment includes splinting, physical therapy, corticostreoid injection, and one of the latest treatment is dextrose 5% perineural injection.[1,4,5]

Injection therapy of perineual with D5% or prolotherapy has become a common procedure for treating CTS. Injection of D5% into the peripheral nerve has been found to provide pain relief in patient with CTS.[4,5]

Althought the prolotherapy has been found to be an effective and safe treatment for mild to moderate CTS,[5] some anatomical variations of the MN could effect the outcome of the prolotherapy in CTS.

Numerous median nerve anatomical

variations have been reported and it is relevant to the treatment.[6] Lanz described the anatomical variations of the MN in the CT and classified it into four groups.[7] The first group is thenar branch variation, second is accessory branches originates at the distal CT, third is high division of the MN, and fourth is accessory branches originated at the proximal CT.

Knowledge in variations of the MN that could effect the outcome of CT is important for clinicians in determining the appropiate treatment or the best approach for the treatment.

CASE REPORT

A 43-year-old woman had suffered a diurnal, nocturnal numbness and parasthesia of the first, second, third and radial surface of the fourth finger of the right hand since three months ago. She also complained of pain and strength reduction of the first, second and third fingers for two months. There was no history of trauma on the left wrist. The VAS score was 8. A scoring was conducted using a Boston Questionnare Score. The result showed a symptom average of 3.27 and a difficulty average of 3.25.

Figure 1. Prolotherapy Injection Technique using ulnar to radial approach

Physical examination showed positive Tinel's sign , Phalen's sign and Durkan's compression test. Mild thenar atrophy was present, together with pain and mild loss of strength. There was no history of polyneuropathy and brachial plexopathy for this patient.

Neuroprolotherapy was performed twice, at the interval of two weeks, using D5% (1cc), lidocaine 1% (1cc). The prolotherapy injection technique is shown in Figure 1. The technique that was performed on the patient is as follows; Patient's position was lying on a bed with supine position while the wrist was in a supinated position. The wrist was also in slight dorsoflexion over a small rolled towel. Transducer was positioned on short axis to the MN and CT at the distal palmar crease, with in plane needle orientation relative to the transducer and ulanr to radial needle approach.

In this case, a bifid MN was found in CT through the ultrasonography imaging, asshown in Figure 2. It seemed that the whole of the perineural median nerve could not be reached by ulnar to radial needle approach.

After a 3-month evaluation since the second injection, a patient evaluation was done by using VAS score, Boston Questionnare score, and DASH score. The result showed a decreased score of VAS from 8 to 4 point. The patient still complained of a persistent numbness and parasthesia in the radial surface of the fourth finger. She also insisted that the muscle strenght was stronger than before the injection.

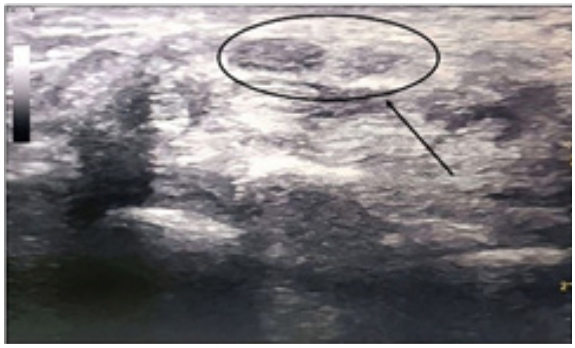

Figure 2. Bifid median nerve (black arrow) variation examined by ultrasonography

Table 1. Boston Questionnare score before injection (Symptom Severity)

No	Questionnaire	1	2	3	4	5
1.	How serious is the wrist pain that the patient has at bedtime?	Normal	Slight	Medium*	Severe	Very serious
2.	How often did wrist symptoms wake the patient up during bedtime in the past two weeks?	Never	Once	Twice or three times*	Four or five times	More than five times
3.	Does the patient have symptoms in their hand or wrist during the day ?	Normal	Slight	Medium*	Severe	Very serious
4.	How many times does the patient have hand or wrist symptom during the day ?	Never	1-2 times/ day	3-5 times/ day	>5 times/ day*	Constant
5.	How long does an episode of symptom last during the day ?	Never	<10 minutes	10-60 minutes	>60 minutes*	Constant pain
6.	Does the patient experience numbness in their hand?	Normal	Slight	Medium	Severe*	Very serious
7.	Does the patient experience muscle weakness in their hand or wrist?	Normal	Slight	Medium*	Severe	Very serious
8.	Does the patient feel tingling in their hand?	Normal	Slight	Medium*	Severe	Very serious
9.	How serious is the numbness or tingling at bedtime?	Normal	Slight	Medium*	Severe	Very serious
10.	How many times did hand numbness or tingling wake the patient up during bedtime during the past two weeks?	Never	Once	Twice or three times*	Four or five times	More than five times
11.	Does the patient have problems with grasping objects such as keys or pens?	No	little	Moderate*	Very difficult	Severe

*the score chosen by the respondent or patient

Table 2. Boston Questionnare score before injection (Difficulty Severity)

Questionnaire	No difficulty	Little difficulty	Moderate difficulty	Intense difficulty	Cannot perform
Write	1	2*	3	4	5
Buttoning of clothes	1	2*	3	4	5
Holding a book while reading	1	2*	3	4	5
Holding the telephone	1	2	3	4*	5
Opening a jar	1	2	3	4*	5
Household work	1	2	3	4*	5
Picking up grocery	1	2	3	4*	5
Bathing	1	2	3	4*	5

*the score chosen by the respondent or patient

Table 3. Boston Questionnare score after injection (Symptom Severity)

No	Questionnaire	1	2	3	4	5
1.	How serious is the wrist pain that the patient has at bedtime?	Normal	Slight*	Medium	Severe	Very serious
2.	How often did wrist symptoms wake the patient up during bedtime in the past two weeks?	Never	Once*	Twice or three times	Four or five times	More than five times

Table 3. Boston Questionnare score after injection (Symptom Severity)

No	Questionnaire	1	2	3	4	5
3.	Does the patient have symptoms in their hand or wrist during the day ?	Normal	Slight*	Medium	Severe	Very serious
4.	How many times does the patient have hand or wrist symptom during the day ?	Never	1-2 times/ day*	3-5 times/ day	>5 times/ day	Constant
5.	How long does an episode of symptom last during the day ?	Never	<10 minutes*	10-60 minutes	>60 minutes	Constant pain
6.	Does the patient experience numbness in their hand?	Normal	Slight*	Medium	Severe	Very serious
7.	Does the patient experience muscle weakness in their hand or wrist?	Normal	Slight*	Medium	Severe	Very serious
8.	Does the patient feel tingling in their hand?	Normal	Slight*	Medium	Severe	Very serious
9.	How serious is the numbness or tingling at bedtime?	Normal	Slight*	Medium	Severe	Very serious
10.	How many times did hand numbness or tingling wake the patient up during bedtime during the past two weeks?	Never	Once*	2-3 times/ day	4-5 times/ day	>5 times/ day
11.	Does the patient have problems with grasping objects such as keys or pens?	No	Little*	Moderate	Very difficult	Severe

*the score chosen by the respondent or patient

Table 4. Boston Questionnare score after injection (Difficulty Severity)

Questionnaire	No difficulty	Little difficulty	Moderate difficulty	Intense difficulty	Cannot perform
Signing	1*	2	3	4	5
Buttoning of clothes	1*	2	3	4	5
Holding a book while reading	1*	2	3	4	5
Holding the telephone	1	2*	3	4	5
Opening a jar	1	2*	3	4	5
Household work	1	2*	3	4	5
Picking up grocery	1	2*	3	4	5
Bathing	1	2*	3	4	5

*the score chosen by the respondent or patient

Table 5. DASH Questionnare before injection

No.	Questionnaire	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
1.	Opening a tight jar	1	2	3	4*	5
2.	Signing	1	2*	3	4	5
3.	Using a key	1	2	3*	4	5
4.	Making a meal	1	2	3*	4	5
5.	Pushing a heavy object	1	2*	3	4	5
6.	Overhead activity	1*	2	3	4	5
7.	Difficult household work	1	2	3	4*	5
8.	Gardening	1	2*	3	4	5

Table 5. DASH Questionnare before injection

No.	Questionnaire	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
9.	Bed making	1	2*	3	4	5
10.	Lifting a grocery	1	2	3	4*	5
11.	Lifting a weighty object	1	2	3	4*	5
12.	Replacing a lightbulb	1*	2	3	4	5
13.	Washing hair	1	2	3	4*	5
14.	Washing back side of body	1	2*	3	4	5
15.	Wearing a sweater	1	2*	3	4	5
16.	Cutting food	1	2	3	4*	5
17.	Exercise activities with little effort	1	2	3*	4	5
18.	Exercise activities with some effort	1	2	3	4*	5
19.	Exercise activities that requires to move your arm freely	1	2	3	4*	5
20.	Fulfilling transportation needs	1	2	3*	4	5
21.	Sexual intercourse	1*	2	3	4	5
No.	**Questionnaire**	**No interference**	**Slight interference**	**Moderate interference**	**Quite interference**	**Extreme interference**
22.	The extent of interferrence that the patient experienced during normal social activites with family, friends, neigbours, or groups during the past week	1	2	3	4*	5
No.	**Questionnaire**	**No Limitation**	**Slight limitation**	**Moderate limitation**	**Quite limitation**	**Extreme limitation**
23.	The extent of limitation in the patient's work and other regular daily activites as a result of the symptoms during the past week	1	2	3	4*	5
No.	**Questionnaire**	**None**	**Mild**	**Moderate**	**Severe**	**Extreme**
24.	Upper extremity discomfort.	1	2	3	4*	5
25.	Upper extremity discomfort on specific activity.	1	2	3	4*	5
26.	Tingling in upper extremity	1	2	3*	4	5
27.	Weakness in your upper extremity	1	2	3*	4	5
28.	Stiffness in your upper extremity	1	2	3*	4	5
No.	**Questionnaire**	**No difficulty**	**Mild difficulty**	**Moderate difficulty**	**Severe difficulty**	**Extreme difficulty (can't sleep)**
29.	The difficulty of sleeping that the patient had because of the pain	1	2	3*	4	5

Table 5. DASH Questionnare Before Injection

No.	Questionnaire	Strongly disagree	Disagree	Neither	Agree	Strongly agree
30.	The patient feels less confident because of their upper extremity symptoms	1	2	3	4*	5

*the score chosen by the respondent or patient

Table 6. DASH Questionnare after injection

No.	Questionnaire	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
1.	Opening a tight jar	1	2*	3	4	5
2.	Signing	1*	2	3	4	5
3.	Using a key	1	2*	3	4	5
4.	Making a meal	1	2*	3	4	5
5.	Pushing a heavy object	1*	2	3	4	5
6.	Overhead activity	1*	2	3	4	5
7.	Difficult household work	1	2*	3	4	5
8.	Gardening	1*	2	3	4	5
9.	Bed making	1	2*	3	4	5
10.	Lifting a grocery	1	2*	3	4	5
11.	Lifting a weighty object	1	2*	3	4	5
12.	Replacing a lightbulb	1*	2	3	4	5
13.	Washing hair	1	2*	3	4	5
14.	Washing back side of body	1*	2	3	4	5
15.	Wearing a sweater	1*	2	3	4	5
16.	Cutting food	1	2*	3	4	5
17.	Exercise activities with little effort	1	2*	3	4	5
18.	Exercise activities with some effort	1	2*	3	4	5
19.	Exercise activities that require to move your arm freely	1	2*	3	4	5
20.	Fulfilling transportation needs	1*	2	3	4	5
21.	Sexual intercourse	1*	2	3	4	5

No.	Questionnaire	No interference	Slight interference	Moderate interference	Quite interference	Extreme interference
22.	The extent of interferrence that the patient experienced during normal social activites with family, friends, neigbours, or groups during the past week	1	2*	3	4	5

No.	Questionnaire	No limitation	Slight limitation	Moderate limitation	Quite limitation	Extreme limitation
23.	The extent of limitation in the patient's work and other regular daily activites as a result of the symptoms during the past week	1	2*	3	4	5

Table 6. DASH Questionnare After Injection

No.	Questionnaire	None	Mild	Moderate	Severe	Extreme
24.	Upper extremity discomfort.	1	2*	3	4	5
25.	Upper extremity discomfort on specific activity.	1	2*	3	4	5
26.	Tingling in upper extremity	1	2*	3	4	5
27.	Weakness in your upper extremity	1	2*	3	4	5
28.	Stiffness in your upper extremity	1	2*	3	4	5
No.	**Questionnaire**	**No difficulty**	**Mild difficulty**	**Moderate difficulty**	**Severe difficulty**	**Extreme difficulty (can't sleep)**
29.	The difficulty of sleeping that the patient had because of the pain	1	2*	3	4	5
No.	**Questionnaire**	**Strongly disagree**	**Disagree**	**Neither**	**Agree**	**Strongly agree**
30.	The patient feels less confident because of their upper extremity symptoms	1	2*	3	4	5

*the score chosen by the respondent or patient

Through the Boston Questionnare Score, an improvement of the symptom averaged to two points and an improvement of the difficulty averaged to 1.63 point were found. It was suspected that the score could have been better if the bifid median nerve was not present. The DASH score before injection was 50, and after injection improved to 17.5. The result of the patient's Boston Questionnare and DASH Questionnare are shown on Table 1, 2, 3, 4, 5, and 6. The asterisk mark indicates the answer that the patient chose.[8–10]

DISCUSSION

CTS is a very common neuropathy disease that occurs within adult population. CTS happens when the MN is compressed beneath the flexor retinaculum. The pathology mechanism of CTS comes from a mix of trauma, increased pressure in the CT, and ischemic damage to the MN.[1,3]

CT can be visualized with a high frequency linear array transducer ultrasound. Swelling of the MN can be seen in short-axis view of the more proximal aspect of the CT, in accordance with the patient's symptoms and severity. Anatomical variants of the MN, such as a bifid median nerve (BMN), persistent median artery, or an ulnar-lying position of the median palmar sensory branch, can also be seen using the ultrasound imaging. Ultrasound has advantages in less cost, painless and shorter examination time compared to other diagnostic tools.[3,11,12]

The management of CTS varies depend on its severity. Conservative treatment is more recommended in patients with mild symptoms. Patients with severe CTS should be offered surgical treatment by decompression. Conservative treatment includes corticosteroids, splint, rehabilitation through physical therapy, and therapeutic ultrasound. One of the latest conservative treatments that has been commonly used is prolotherapy.[1,3,4]

Prolotherapy, also known as proliferative therapy (PT), has been reported to be an effective method to treat CTS and also other musculoskeletal problem. A study has shown that

prolotherapy gives significant reduction in VAS score and disability score, an improved electrophysiological response, and also a decreased CSA (cross-sectional area) of the MN in six months after treatment. One study shows that prolotherapy gave similar outcome on patient's paint score compared to platelet-rich plasma or steroid injection. Corticosteroid can only provide short-term improvement, and it has been mentioned that it could increase the risk of tissue atrophy. On the other hand, PT has shown to provide a long-term improvement, and it also able to induce regeneration of soft tissue.[4,5,13]

The mechanism of how perineural D5% injection works is multifactorial. Dextrose prevents inflammation of a neuron, by inhibiting the capsaicin sensitive receptors and preventing substance P and calcitonin gene related peptide to be secreted. Those two substance are known to produce inflamation that leads to pain and swelling of the nerve and/or the tissue that surrounds it. D5% injection can also initiate nerve hydro dissection which is used to prevent nerve trauma and detach the soft tissues. If injection of dextorese was done around the nerve tissue, the extracellur dextrose's concetration will be elevated and thus hyperpolarize the C fibres. Therefore the process of transduction on noxious signals would be decreased.[4,5]

The MN originates from the bachial plexus which comes from the root nerve C5 to T1. After that, the MN courses laterally close to the brachial artery and then passes near the insertion of coracobracialis muscle. The MN enters the cubital fossa and lies posteriorly from the cubital aponeurosis, anterior to the brachialis and then between the humeral and radial heads of the pronator teres. And then the MN courses between the flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP). Proximal to the flexor retinaculum, it courses laterally from the FDS and becomes superficial between the tendons of FDS and flexor carpi radialis. Distal to the CT, the MN gives off a motoric function for the thenar compartment and the first and second lumbricalis muscle. And also a sensoric function that subdivides into four digital palmar branches.[14–18]

Variations of MN branches have been reported as one of the prevalences of MN entraptment.[2,19,20] Lanz has made a clasification of variations of the MN into four groups: First, the thenar branch variation; second, the accessory branches originates at the distal CT; third, the high division of the MN; and fourth, the accessory branches originated at the proximal CT.[7]

The prolotherapy treatment was done twice using D5% (1cc) and lidokain 1% (1cc), at a two-week interval. Guiding ultrasound was done with the short axis view technique to get a visualization of the CT. The injection technique was performed by an inline position and an ulnar to radial approach. However, in this case of CTS, there was a rare variation of the median nerve. An anatomical variant of bifid median nerve was found during the ultrasound diagnostic examination. The improvement was moderate. A persistent tingling on the radial side of the ring finger, mild pain from the VAS score, moderate improvement of the Boston questionnaire score and the DASH score show that the impovement was not sufficient.

This may be due to the injection technique that was performed; the injection could not reach the whole of the median nerve with a bifid anatomical variant. The author suggested to modify the injection by adding another technique of injection, with the intention of reaching the whole of the bifid MN. The additional technique could be with transducer position in long axis to the MN, outplane needle orientation, and proximal to distal approach on the MN.

CONCLUSION

Evaluation and clinician's knowledge of the anatomical anomaly of the median nerve bifid is required. In the case of a bifid MN, it is necessary to modify the injection technique so it would be

more able to reach the whole of the bifid MN. The additional modified injection technique could be with transducer position in long axis to the MN, outplane needle orientation, and proximal to distal approach on the MN. Further studies are required to determine a more efficient way in treating CTS with bifid MN.

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