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 variation 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 questionnaire 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 variation.

Discussion: Variation of median nerve branches has been reported as one of the prevalence of median nerve entrapment. 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 management 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 perineural 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

Although 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 affect the outcome of the prolotherapy in CTS.

Numerous median nerve anatomical
variations have been reported and it is relevant to the treatment. Lanz described the anatomical variations of the MN in the CT and classified it into four groups. 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 appropriate 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 Questionnaire Score. The result showed a symptom average of 3.27 and a difficulty average of 3.25.

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 ulnar to radial needle approach.

In this case, a bifid MN was found in CT through the ultrasonography imaging, as shown 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 Questionnaire 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 strength was stronger than before the injection.
1. How serious is the wrist pain that the patient has at bedtime? (Table 1, Boston Questionnaire score before injection (Symptom Severity))

| No | Questionnaire | 1 | 2 | 3 | 4 | 5 |
|----|---------------|---|---|---|---|---|
| 1. | Normal | Slight | Medium | Severe | More serious |
| 2. | Never | Once | Twice or three times | Four or five times | Very serious |
| 3. | Normal | Slight | Medium | Severe | Very serious |
| 4. | Never | 1-2 times/day | 3-5 times/day | >5 times/day | Constant |
| 5. | Never | <10 minutes | 10-60 minutes | >60 minutes | Constant pain |
| 6. | Normal | Slight | Medium | Severe | Very serious |
| 7. | Normal | Slight | Medium | Severe | Very serious |
| 8. | Normal | Slight | Medium | Severe | Very serious |
| 9. | Normal | Slight | Medium | Severe | Very serious |
| 10. | Never | Once | Twice or three times | Four or five times | More than five times |
| 11. | No | little | Moderate | Severe | Very difficult |

*the score chosen by the respondent or patient

2. How often did wrist symptoms wake the patient up during bedtime in the past two weeks? (Table 2, Boston Questionnaire 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

3. How serious is the wrist pain that the patient has at bedtime? (Table 3, Boston Questionnaire score after injection (Symptom Severity))

| No | Questionnaire | 1 | 2 | 3 | 4 | 5 |
|----|---------------|---|---|---|---|---|
| 1. | Normal | Slight | Medium | Severe | Very serious |
| 2. | Never | Once | Twice or three times | Four or five times | More than five times |
Table 3. Boston Questionnaire score after injection (Symptom Severity)

| No  | Questionnaire                                                                 | Score                                                                 |
|-----|-------------------------------------------------------------------------------|----------------------------------------------------------------------|
| 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 Questionnaire 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 Questionnaire 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 Questionnaire 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 interference that the patient experienced during normal social activities with family, friends, neighbours, or groups 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 Questionnaire 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 Questionnaire 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 light bulb | 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 interference that the patient experienced during normal social activities with family, friends, neighbours, 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 activities as a result of the symptoms during the past week | 1 | 2* | 3 | 4 | 5 |
Table 6. DASH Questionnaire 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 Questionnaire 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 Questionnaire and DASH Questionnaire 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 inflammation 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 dextrose was done around the nerve tissue, the extracellular dextrose’s concentration 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 banchial 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 coracobrachialis muscle. The MN enters the cubital fossa and lies posteriorly from the cubital aponeurosis, anterior to the brachial 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 entrapment,2,19,20 Lanz has made a classification 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 improvement 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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