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Intramuscular Sensory Neurolysis: A New Technique to Control Spasticity

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This preliminary report demonstrated a new technique, “intramuscular sensory neurolysis” (IMSN), to control the muscle spasticity. Similar to myofascial trigger point (MTrP) injection, the needle were rapidly inserted, for a short distance (1 mm) each thrust, into the MTrP region (in the endplate zone) to elicit local twitch responses to identify the terminal sensory fibers for phenol injection. Immediate relief of spasticity was noticed both subjectively and objectively after IMSN. As compared with the traditional motor point block, the advantage of IMSN includes: 1) less time (usually 3-5 minutes for each MTrP region) required to perform the whole procedure in a site, 2) less amount of phenol solution required to inject a muscle to obtain significant therapeutic effectiveness, 3) less trauma to muscle, 4) Less systemic side effects, 5) no obvious side effect of motor weakness, and 6) less cost. (J Rehab Med Assoc ROC 2001; 29(1): 43 – 49)

Key words: intramuscular neurolysis, motor point block, myofascial trigger points, spasticity

INTRODUCTION

Intramuscular neurolysis (motor point block) with phenol has been used for the treatment of spasticity. The classical method to inject phenol into the endplate zone requires threshold current stimulation to identify the intramuscular motor nerve fibers so that phenol solution can be injected accurately to the motor nerve fibers. The therapeutic effectiveness has been well documented. However, it is a time consuming procedure. It also requires expensive equipment to perform this procedure. One of the significant side effects is motor weakness if the injected muscle is not completely paralyzed.

Recent studies on myofascial trigger point (MTrP) suggested that there are multiple MTrP loci in an MTrP region and that an MTrP locus has a sensitive locus (sensitized nociceptive nerve endings) and an active locus (dysfunctional endplates) as demonstrated in Figure 1. An MTrP is always found in the endplate zone. When an MTrP locus is encountered by a needle tip (high-pressure stimulation), local twitch response (LTR) can be elicited. LTR is a quick and brief contrac-


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tion of muscle fibers in the taut band that contains the stimulated MTrP. Therefore, when an LTR is elicited by a needle tip, the needle tip is right on a sensitive locus or a few sensitive loci (nociceptive nerve endings) in an MTrP region (i.e. near an endplate)\(^{19,20,28}\). Motorneuron excitability can be influenced by the impulses from nociceptive nerve endings. Therefore, if one can apply neurolytic agent (such as phenol) into the sensitive loci in an MTrP region, the motorneuron excitability may be suppressed. It is reasonable to apply this procedure to control the spasticity.

This brief preliminary report introduced a new technique, intramuscular sensory neurolysis (IMSN), which can effectively block the intramuscular sensory nerve endings to control the spasticity by using similar procedure of MTrP injection.

### Neurolytic Solution:

Similar to the traditional procedure of intramuscular neurolysis, 5% phenol can be used for IMSN. This solution can be prepared by adding crystalline phenol (5%) into distilled water which contains sodium bisulfate (0.1%) and Sodium-EDTA (0.05%) \(^{[1]}\). Approximately 1-2 cc of 5% phenol may be used for each MTrP region in the muscle. In some large muscles, two or more MTrP regions may require phenol injection. The exact amount of phenol solution depends on the number of sensitive loci (LTR loci) identified. In fact, the number of sensitive loci is proportionate to the activity of that MTrP, and is probably also related to the degree of spasticity. For a patient with intact sensory function or with hyperesthesia or allodynia, 1 cc of 1% xylocaine can be added to reduce pain during phenol injection.

### Needle and Syringe:

It is recommended to use a 5-cc or 10-cc syringe and a 25 gauge, 1/2 inch needle (for a deep or thick muscle) or a 27 gauge, 1/4 needle (for a superficial and thin muscle) for phenol injection. The syringe is usually held by the dominant hand and is basically fixed by the thumb and middle finger of the dominant hand. The index finger of the dominant hand is placed on the top of the syringe to push the solution into the muscle. The palmar aspect of the wrist and proximal end of the hand is placed on the body part near the injection site so that it is comfortable to move the syringe to push the needle into the muscle. In this way, over-penetration of the needle can be avoided if the patient moves in response to pain from needle penetration. This technique of needle holding is particularly essential if important tissue or organ is just under the injection site (i.e. anterior neck muscles, pectoralis muscles, intercostal muscles etc.)\(^{21,24,29}\).

### Identification of MTrP:

An MTrP can usually be identified in the endplate zone, or near the motor point, of a muscle. It can also be easily identified following the instruction described in Travell & Simons’ Myofascial Trigger Point Manual\(^ {29,30}\). An MTrP is always found in a taut band which can be palpable by using flat palpation or pinch palpation\(^{21,29,30}\). When the sensory function is partially or completely preserved, an MTrP can be further confirmed by patient’s verbal report of most tender spot.

### Injection Procedure:

The procedure of IMSN is similar to MTrP injection recommended by Hong\(^ {23-25}\). The syringe which contains adequate amount of phenol solution is held by the dominant hand, while the MTrP is compressed with the index or middle finger of the non-dominant hand. Then the needle can accurately penetrate into the MTrP (Fig. 2). The needle penetrates through the skin into the subcutaneous tissue adjacent to the palpated MTrP region at an angle of approximately 50-70 degrees. Then the needle is further moved into the muscle fibers in the MTrP region in a straight track with multiple thrusts rapidly ("fast in" technique as described in MTrP injection\(^ {23-25}\)). For each rapid thrust, the needle is thrust into the muscle for a short depth approximately 1 mm. A drop of neurolytic solution (approximately 0.05 - 0.1 ml) is injected each time an LTR is elicited. Repeated thrusts are applied in the same track of needle insertion to explore for LTRs until the needle reaches an estimated depth correspondent to the diameter of that muscle. The needle is then withdrawn to the subcutaneous tissue layer but not out of the
skin. Similar procedure is applied to inject another track at a different angle (direction) in the same MTrP region to elicit more LTRs. Approximately 10-15 tracks are searched for LTR loci (sensitive loci) in one MTrP region.

Similar to MTrP injection, precaution should be taken carefully for each muscle as described in Travell & Simons’ Trigger Point Manual[21,22,23].

For patients with incomplete sensory loss, they may be unable to tolerate pain from injection. One cc (or less) of 1% xylocaine may be added to reduce pain and discomfort. This is particularly important for a small child.

**After Care:**

Immediately after injection, the injected area should be compressed firmly for at least 3 minutes for the purpose of hemostasis. Then the adhesive tape is applied firmly over the whole injected area which is covered with a cotton or gauze to enforce the effects of pressure dressing.

**Results of Preliminary Experience**

**Assessment of Therapeutic Effects:**

In the past 5 months, 30 patients (mean age: 47.3±19.6 years) with spasticity were treated with IMSN. The duration after onset of spasticity was longer than one year. All subjects had deep tendon reflexes of the involved muscle with degrees of 3+ or higher (i.e. severe spasticity). Muscles with atrophy (very unlikely to have atrophy in a spastic muscle) or contracture were not selected for injection, since the functional improvement after relief of spasticity would be quite limited. The muscle groups which had been injected included one patient for shoulder-adductor group (pectoralis major and minor, latissimus dorsi), 3 patients for elbow-flexor groups (biceps brachii, brachialis, brachioradialis, pronator teres), 6 patients for hip-adductor groups (adductor magnus, adductor longus, gracilis, pectinits), 6 patients for knee flexor groups (biceps femoris long head & short head, semimembranosus, semitendinosus), and 14 patients for ankle plantar flexor groups (gastrocnemius, soleus, flexor digitorum longus). Immediately before and immediately after the injection, the muscle spasticity was assessed with subjective feeling by the examiner and the deep tendon reflex (objective assessment, but not well quantified) of the injected muscle. The assessment of effectiveness was performed by a physician who did not perform the IMSN procedure.

**Results:**

In objective assessment, tendon reflexes were reduced in 17 muscle groups (56.7%). Based on the subjective estimation, it was found that immediate relief of spasticity was noticed in all treated muscles (100%). The *remarkable* effectiveness in subjective assessment was found in 3 of 8 (37.5%) cerebral palsy patients, 1 of 3 (33.3%) cerebral hemorrhage patients, 2 of 8 (25%) cerebral infarction patients, 1 of 5 (20%) spinal cord injury patients, and 1 of 6 (16.7%) traumatic brain injury patients. On the other hand, *less* effectiveness was found in 3 of 8 (37.5%) cerebral palsy patients, none of 3 (0%) cerebral hemorrhage patients, 1 of 8 (12.5%) cerebral infarction patients, 3 of 5 (60%) spinal cord injury patients, and 2 of 6 (33.3%) of traumatic brain injury patients. The rest of patients had moderate effectiveness.
The major side effects of IMSN included paresthesia, burning sensation, tingling, numbness, and post-injection ecchymosis. Only 3 patients (10%) had complete sensory loss before injection. Among the other 27 patients with preserved sensation (17 with normal sensation and 10 with partial sensation), 6 patients (22.2%) developed paresthesia, 3 patients (11.1%) developed burning sensation, and 2 patients (7.4%) developed tingling and numbness. Only one patient developed post-injection ecchymosis at the site of injection after IMSN. All the complications disappeared within one week after injection. Before injection, only 4 patients (13.3%) had complete paralysis of the injected muscle groups. None of the other 26 patients with incomplete paralysis in the injected muscle groups developed post-injection weakness of those muscle groups.

**DISCUSSION**

This special technique was developed based on the current pathophysiological concept of myofascial trigger point. It has been confirmed that MTrP is always identified in the endplate zone of skeletal muscle. Stimulation of sensory fiber in the MTrP locus can elicit LTR. Block of sensory fibers in the MTrP region may reduce the excitability of motoneurons. This new procedure, IMSN, can effectively reduce the spasticity based on the preliminary clinical study.

The traditional intramuscular neurolysis can block the terminal branches of motor nerve, or the branches of mixed nerve. To perform this procedure, the terminal nerve fibers can be identified by using electrical stimulation with threshold current, or by recording the endplate potentials with EMG machine. Both procedures are time consuming. IMSN requires less time than the traditional methods. For each motor point (MTrP region), it usually requires 3-5 minutes to complete the procedure. The traditional procedures also require special equipment (electric stimulator or EMG machine). The cost is much higher than the new technique, IMSN. The amount of phenol required to perform the traditional motor point block is approximately 5 cc for each point, while only 1-2 cc of phenol is required for IMSN to obtain the therapeutic effectiveness. Though the cost of phenol is not critical, the reduced amount of phenol would reduce the possibility of systemic side effects. The cost of IMSN is much less than BOTOX injection for spasticity control.

Post-injection weakness is a major problem in patients who have incomplete impairement of motor function and have received treatment of spasticity with traditional intramuscular neurolysis. In this report, no subject developed motor weakness in the muscle groups treated with IMSN.

The size of the needle used for IMSN is #25 or #27. Small needle would cause less pain and less damage to the muscle fibers or other structures (such as vessels or nerves). The dual-duty hypodermic needle (for both injection and stimulation or recording) is usually bigger than size #25. However, this may not be a critical issue since the smaller hypodermic needle can be developed with current high technology.

It has been found that more sensory complaints (though temporary) were found in patients treated with IMSN than the traditional technique. Therefore, it seems more appropriate to apply IMSN on patients with complete sensory loss.

Another problem with IMSN is that it requires high skill to perform IMSN, especially when the distance of each needle thrust is limited to 1 mm. The technique of IMSN is much more difficult than the traditional method. A clinician who can do MTrP injection (Hong’s technique) skillfully can also perform IMSN easily. In practice, the distance of each needle thrust is not exactly limited to 1 mm. A longer distance of needle movement in this procedure still can also identify sensitive loci, and can obtain a certain degree of relief in spasticity, although the overall effectiveness may be less than that performed with a small-distance needle thrust. The ideal procedure is to elicit as many (but never be “all”) LTRs as possible. In traditional motor point block, probably only 15% (or less) of intramuscular nerve endings are blocked. Excessive block may cause flaccid paralysis of a muscle. It is an optimal status that the spasticity is reduced but some muscle tone is still preserved to avoid side effects of flaccidity.

The term “intramuscular sensory neurolysis” is used for this technique based on the fact that an LTR is elicited by stimulation of sensitized sensory nerve endings. However, the basic MTrP unit consists of two compo-
ments (sensitized sensory nerve fibers and abnormal endplates) and these two components are closely located. Therefore, it is not unlikely that both terminal sensory fibers and endplates (or even terminal motor fibers) are affected by the phenol which has been injected into the MTrP region. Based on the fact that more sensory complaints were noticed with IMSN than traditional motor point block and that motor weakness was not obvious in this preliminary report, it is assumed that mainly sensory fibers were blocked by phenol when this procedure, IMSN, was applied.

Unfortunately, it is unclear how long the therapeutic effectiveness of IMSN may last. The hard data is still not available. In this study, more than 50% of cases treated with IMSN had good results for longer than two months. Continuous follow-up study for a long period on large samples based on objective and quantitative measurements (such as Modified Ashworth scale, motor neuron excitability index, surface EMG activity, etc.) is required to obtain a final conclusion.

Summary:

The advantage of IMSN, as compared to the traditional intramuscular neurolysis, includes: 1) IMSN mainly blocks the sensory fibers rather than motor fibers as the traditional methods so that post-injection motor weakness is minimum, 2) IMSN takes less time (usually 3-5 minutes for each MTrP region) to perform the whole procedure in a site, and thus causes less trauma to muscle fibers, than the traditional methods, 3) IMSN requires less amount of phenol solution, and thus, causes less systemic side effects or local damage to muscle fibers, than the traditional procedure to inject a muscle, and 4) The price to block a muscle by using IMSN is much less than traditional phenol motor point block or BOTOX (Botulinum toxin) injection. The disadvantage of IMSN includes: 1) IMSN may cause more sensory complications (such as tingling, paresthesia, burning pain) than the traditional procedure, 2) IMSN requires a more skillful technique than the traditional procedure.

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肌内內感覺神經阻斷術：控制痙攣狀態之新方法

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此報告乃初試「肌內內感覺神經阻斷術」(IMNS) 來控制痙攣狀態之成果展示。IMNS 之注射法類似「肌激痛點(MTrP)之注射法」，亦即使用快速、短距(1mm)針刺 MTrP 以引發「局部抽搐反應」來確認感覺神經末梢之位置，以便注入石炭酸（Phenol）。結果顯示不論是主觀或客觀之評估，皆可看出立即減少「痙攣狀態」。此方法之優點包括：(一) 需時每一 MTrP 只須 3-5 分鐘)較短，(二) 石炭酸之用量較少，(三) 對肌肉傷害較少，(四) 較無全身性副作用，(五) 較無肌無力之副作用，(六) 費用較低。（中華復健醫誌 2001; 29(1): 43-49）

關鍵詞：肌內內神經阻斷術(intramuscular neurolysis)，運動點阻斷(motor point block)，肌激痛點(myofascial trigger point)，痙攣狀態(spasticity)