Our Experience of Muscle Afferent Block for dystonia and spasticity

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Abstract

Muscle Afferent Block (MAB) has been shown to improve clinical symptoms of writer's cramp, cervical dystonia, spastic paraparesis, and oromandibular dystonia. However, this therapy is not yet used to a sufficient extent. In this article, we review our experience with this new treatment. The subjects were 11 cases encountered between November, 2001 and April, 2002, including 4 cases of focal dystonia of an upper limb, 3 cases of spastic paralysis of an upper limb, 3 cases of spastic paraparesis, and 1 case of spasmodic torticollis. All patients exhibited some clinical improvement. Two cases of facial flushing and 3 cases of muscle weakness occurred as side effects. All of them were mild and transient. We conclude that MAB is a useful treatment for dystonia and spasticity with low incidence of side effects.

Introduction

In 1924, Walshe reported that intramuscular injection of diluted procaine alleviated rigidity in a patient with Parkinsonism. This report had been ignored for years, but on the basis of this report, Kaji et al. reported the efficacy of 0.5% xylocaine and 99% ethyl alcohol for writer's cramp in 1995. This therapy is currently applied to upper limb dystonia including writer's cramp, spasmodic torticollis, spastic paraparesis, upper limb spasticity, and oromandibular dystonia, and has been reported to be likely to show invariable efficacy.

We performed MAB in 11 patients at our department from November 2001 to April 2002, and confirmed that symptoms were alleviated just after the therapy (short-term efficacy) in all patients and that alleviation of the symptoms lasted for at least 1 week in 9 patients as of April 2002. In this report, we explain the technique of MAB and report the therapeutic results obtained at our department.

Principle of MAB and Its Technique in Practice

Walshe thought that blockade of sensory afferent fibers by local anesthetics led to hypotonia, but this hypothesis has been denied on the basis of electrophysiological findings. Local anesthetics at a low concentration are known to block short-diameter fibers selectively, and it has been hypothesized that in MAB, xylocaine at a low concentration blocks gamma-afferent small fibers, regulating the sensitivity of muscle spindles, resulting hypotonia. However, this hypothesis has not been proved, and the principle of MAB is poorly understood.

Kaji et al. did not only selected xylocaine, a safer drug than procaine, but also reduced the total dose of 0.5% xylocaine to be used in one occasion of the therapy to 50 ml on the basis of the safety margin. In addition, they used ethyl alcohol, which is known to block Na+ channels in nerve fibers like other local anesthetics, at the dose equivalent to 10% of the total dose of xylocaine, to maintain the efficacy.

One syringe containing 10 ml of 0.5% xylocaine and the other containing 99% ethyl alcohol are connected to a three-direction stopper which is connected to an injection needle through an extension tube. A 27-gauge injection needle is inserted into the target muscle...
identified by inspection, palpation, and if necessary, superficial electromyography, and 8 ml of 0.5% xylocaine is injected. Every time before injection, it should be confirmed that there is no backflow of blood. One ml of 99% ethyl alcohol and then 2 ml of 0.5% xylocaine are injected, and the injection needle is removed. Xylocaine is injected in the end of this therapy to prevent leakage of alcohol remaining in the injection needle, which may cause severe pain. Local pain due to ethyl alcohol is the most common adverse reaction of this therapy. Injection needles with a unipolar electrode are useful for confirming that the injection needle is inserted in the target muscle, but they are unavailable in Japan.

The above is the conventional technique of MAB in practice explained in the textbook written by Kaji et al. Since the efficacy of MAB can be maintained for a long period by providing this therapy repeatedly, the success of the therapy depends on whether we could reduce the pain due to alcohol. At first, we decreased the concentration of ethyl alcohol to 10% to eliminate pain, but failed to prevent pain due to alcohol when we injected xylocaine accounting for 80% of the total dose before alcohol injection and xylocaine accounting for 20% of the total dose after alcohol injection. Accordingly, the dose of xylocaine injected before alcohol injection was reduced to 60% and that after alcohol injection was increased to 40%. After this modification, we have not experienced any local pain due to alcohol so far (Table 1).

When an extension tube is used, the amount of the drug remaining in the tube is not negligible, and the amount of the drug actually injected would be inaccurate. The same problem occurs when the injection needle is connected directly to a three-direction stopper. Accordingly, we do not use either a three-direction stopper or an extension tube. We inject xylocaine or ethyl alcohol through the needle kept inserted to the target muscle by exchanging the syringes. This technique requires more attention to keep clean, but we have not experienced any cases of infection or inflammation. The problems we have encountered with this technique are as follows: 1) the syringe and injection needle were connected so tightly that we could not separate them; and 2) excessive pressure added to the syringe during intramuscular injection of the dosing solution led to separation of the syringe and injection needle, and the dosing solution fell on the patient and medical staffs. We have succeeded in preventing these accidents by taking care not to connect the injection needle to the syringe too tightly and to keep the connection site firmly during injection of dosing solutions.

It is considered appropriate to provide MAB once or twice a week. Kaji et al. have reported that MAB provided twice a week for spasmodic torticollis caused muscle hardness. On the other hand, Matsumura et al. reported that MAB provided once a week was more effective than that provided once in 2 weeks. On the basis of these reports, we provide MAB once a week, in principle, according to the condition of individual patients who are treated on an outpatient basis.

**Therapeutic Results at Our Department (Table 2)**

We performed MAB in 4 patients with dystonia localized to upper limbs, 3 patients with upper limb spasticity, 3 patients with spastic paraparesis, and 1 patient with spasmodic torticollis by April 2002. Improvement in writing (Figure 1) and alleviation of abnormal position were observed in patients with upper limb dystonia including writer’s cramp. Patients with upper limb spasticity became able to extend their upper limbs easily. Patients with spastic paraparesis exhibited improvement in walking resulting from alleviation of lower limb spasticity. The intensity of spasticity was evaluated according to the modified Ashworth Score (Table 3) before therapy and after 10th therapy (or at the last therapy in patients who underwent the therapy)

**Figure 1** Writing pre- and post-MAB therapy of patient 2. The writing of post-MAB is improved.
Table 1 The procedure of MAB in our department

1: Select the target muscle by inspection, palpation, and if necessary, superficial electromyography.
2: Sterilize the skin with ethyl alcohol.
3: Inject 6 ml 0.5% xylocaine intramuscularly with a 27-gauge needle.
4: Inject 1 ml 10% ethyl alcohol intramuscularly exchanging the injectors with the injection needle left in the target muscle.
5: Inject 4 ml 0.5% xylocaine intramuscularly exchanging the injectors with the injection needle kept left in the target muscle.
6: Remove the needle.

Table 2 Therapeutic Results in Our Department

<table>
<thead>
<tr>
<th>Age/SEX</th>
<th>Disease</th>
<th>Effects</th>
<th>mAS(pre-therapy)</th>
<th>mAS(post-therapy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>44/male</td>
<td>focal dystonia in hand</td>
<td>improvement of finger extension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>68/male</td>
<td>writer's cramp</td>
<td>improvement of writing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48/male</td>
<td>writer's cramp</td>
<td>improvement of writing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51/male</td>
<td>writer's cramp</td>
<td>improvement of writing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54/male</td>
<td>spasticity in upper limb</td>
<td>improvement of arm extension and clothing</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>81/female</td>
<td>spasticity in upper limb</td>
<td>improvement of arm extension</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>46/female</td>
<td>spasticity in upper limb</td>
<td>improvement of arm extension</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>55/male</td>
<td>spastic paraparesis</td>
<td>improvement of gait</td>
<td>3</td>
<td>1+</td>
</tr>
<tr>
<td>32/male</td>
<td>spastic paraparesis</td>
<td>improvement of gait</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>59/male</td>
<td>spastic paraparesis</td>
<td>improvement of gait</td>
<td>3</td>
<td>1+</td>
</tr>
<tr>
<td>55/male</td>
<td>spasmodic torticollis</td>
<td>improvement of posture and neck pain</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(mAS: modified Ashworth Score)

Table 3 Modified Ashworth Score

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>no increase in muscle tone</td>
</tr>
<tr>
<td>1</td>
<td>slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension</td>
</tr>
<tr>
<td>1+</td>
<td>slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM</td>
</tr>
<tr>
<td>2</td>
<td>more marked increase in muscle tone through most of the ROM, but affected part(s) easily moved</td>
</tr>
<tr>
<td>3</td>
<td>considerable increase in muscle tone, passive movement difficult</td>
</tr>
<tr>
<td>4</td>
<td>affected part(s) rigid in flexion or extension</td>
</tr>
</tbody>
</table>
less than 10 times as of April 2002). As a result, all patients with spasticity showed improvement of at least 2 points. Since shortening of the sternocleidomastoid muscle with hypertrophy was observed, the patient with spasmodic torticollis was treated only with xylocaine, but exhibited alleviation of pain.

Adverse reactions observed were 2 events of facial flushing due to alcohol and 3 events of muscle weakness. All these adverse reactions were mild and transient, and resolved without leading to any sequela. After the above modification, no local pain due to alcohol has been observed.

Discussion
Dystonia has been treated not only by drugs but also by surgical operation and biofeedback, but the therapeutic efficacy of these therapies has been variable and not sufficiently high. Spasticity has been treated not only by drugs but also by rehabilitation, application of appliances, and surgical operation, but the therapeutic efficacy of these therapies was variable, as was the same as for dystonia, and normal daily activities were often disturbed.

In many countries, use of botulinum toxin for dystonia and spasticity has been approved. Although a large quantity of the toxin leads to antibody production, this therapy is known to be effective. In Japan, however, it is impossible to use botulinum toxin for dystonia or spasticity because its application is limited to blepharospasm, hemifacial spasm, and spasmodic torticollis, as of June 2002.

MAB, which was developed on the basis of the above background, has shown invariable efficacy for dystonia and spasticity. Local pain due to alcohol has been a concern related to the therapy, but it has not been observed after making the partial modification to the therapy. Although the mechanism of MAB has not been elucidated, and it has a number of issues to be resolved, such as long-term efficacy, a kind of local anesthetics and alcohol to be used, and their concentrations and doses, it is possible that MAB will be a potent therapy for dystonia and spasticity for which it has been difficult to obtain satisfying therapeutic effects with conventional methods. Further investigations in more patients are necessary to establish the efficacy and safety of this therapy.

Conclusion
MAB was performed in 11 patients with dystonia or spasticity. We modified the conventional procedure and succeeded in preventing local pain due to alcohol. The modified procedure was confirmed to be effective with no serious adverse drug reactions. Further investigations in more patients are necessary.

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References

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