Electroacupuncture direct to spinal nerves as an alternative to selective spinal nerve block in patients with radicular sciatica – a cohort study

Motohiro Inoue, Tatsuya Hojo, Tadashi Yano, Yasukazu Katsumi

Abstract
We applied electroacupuncture to the spinal nerve root by inserting needles under x ray imaging in three cases with radicular sciatica, as a non-pharmacological substitute for lumbar spinal nerve block. In all three cases, symptoms were markedly reduced immediately after electroacupuncture to the spinal nerve root. The sustained effect was noticeably longer than that of spinal nerve blocks previously performed, in two out of the three cases. We suggest that descending inhibitory control, inhibitory control at the spinal level, inhibition of potential activity by hyperpolarisation of nerve endings, or changes in nerve blood flow may be involved in the mechanism of the effect of electroacupuncture to the spinal nerve root. These results suggest that electroacupuncture to the spinal nerve root may be superior to lumbar spinal nerve block when it is applied appropriately in certain cases of radicular sciatica, taking into consideration patient age, severity of symptoms and duration of the disorder.

Keywords
Radicular sciatica, electroacupuncture, selective lumbar spinal nerve block.

Introduction
It is generally known that acupuncture therapy applied to lumbar muscle and fascia is effective for relieving low back pain originating from these tissues. Since acupuncture has little effect in treating radicular sciatica, however, there is a call for the development of more effective acupuncture therapy. On the other hand, at pain clinics and orthopaedic departments and centres, one conservative treatment frequently employed for radiculopathy is selective spinal nerve block (SNB). While used as a highly effective treatment to alleviate the symptoms of radiculopathy, SNB is also a valuable diagnostic tool for determining the lumbar level at which a disorder is located.

We employed a technique similar to the selective SNB to treat radicular sciatica, inserting an acupuncture needle as close as possible to the relevant nerve root, to investigate the effects of applying low frequency electroacupuncture directly to the spinal nerve root (EASNR).

Methods
Cohort
The three cases selected as subjects suffered from radicular sciatica and intermittent claudication due to lumbar spinal canal stenosis (Table 1). The three patients had been treated with poultices, oral NSAIDs, injection of local anaesthetic into the lumbar muscle region, and massage of the low back and leg, before undergoing EASNR. Prior to receiving EASNR, two of the three cases underwent SNB, so a comparison could be made of the relative effectiveness of SNB and EASNR.

The Ethics Committee of Meiji University of Oriental Medicine approved this study. Written informed consent to participate in the study was obtained from all subjects.

EASNR
Having ascertained that the symptoms, x ray film and MRI findings pointed to a nerve root disorder, two acupuncture needles (90mm in length; 0.24mm diameter) were inserted in the part of the nerve root that emerges from the intervertebral foramen (ventral side of transverse process) under
Electrical acupuncture was conducted using the acupuncture needles as electrodes as shown in Figures 1 and 2. The stimulation characteristics were as follows: spike wave-form at 2Hz for 10 minutes, with the stimulation strength set to a level to create sensation in the area of innervation of the nerve root (Pointer F-3, Ito Co Ltd).

**Table 1** Details of the cases

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex</th>
<th>Age</th>
<th>Diagnosis</th>
<th>Duration</th>
<th>Symptoms</th>
<th>X ray film, MRI findings</th>
<th>Nerve root affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>84</td>
<td>Lumbar spinal canal stenosis</td>
<td>7 years</td>
<td>Right back and lower extremity pain and numbness (L4 area) Spinal claudication (50 m)</td>
<td>x ray: Intervertebral space and intervertebral foraminal narrowing at and below L2/3 MRI: Spinal canal stenosis at and below L3/4, with narrowing particularly at the L4/5, L5/S1 intervertebral disc level (predominantly on right side), zygapophyseal joint and yellow ligament hypertrophy</td>
<td>L4 right</td>
</tr>
<tr>
<td>2</td>
<td>Male</td>
<td>69</td>
<td>Lumbar spinal canal stenosis</td>
<td>5 years</td>
<td>Left back and lower extremity pain and numbness (L5/S1 areas) Spinal claudication (50 m)</td>
<td>x ray: Intervertebral foraminal narrowing (zygapophyseal joint hypertrophy) at and below L3/4 MRI: Spinal canal stenosis at and below L4/5 intervertebral disc level, particularly at the L4/5 intervertebral disc level (predominantly on left side)</td>
<td>L5/S1 left</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>74</td>
<td>Lumbar spinal canal stenosis</td>
<td>9 years</td>
<td>Right back and lower extremity pain and numbness (L5/S1 areas) Spinal claudication (100 m)</td>
<td>x ray: Intervertebral spaces and intervertebral foraminal narrowing at and below L2/3 MRI: Spinal canal stenosis at and below L4/5 intervertebral disc level (predominantly on right side)</td>
<td>L5/S1 right</td>
</tr>
</tbody>
</table>

*x ray fluoroscopy, with at least one of the needles located in a position close enough to permit stimulation of the nerve root. Electrical acupuncture was conducted using the acupuncture needles as electrodes as shown in Figures 1 and 2.

The stimulation characteristics were as follows: spike wave-form at 2Hz for 10 minutes, with the stimulation strength set to a level to create sensation in the area of innervation of the nerve root (Pointer F-3, Ito Co Ltd).

**Figure 1** This figure is a schematic diagram of the nerve root acupuncture stimulation sites. Referred pain in the distribution controlled by the nerve root was confirmed on inserting two acupuncture needles to the affected part of the nerve under x ray fluoroscopy.

**Figure 2** This is an x ray image of right L5/S1 EASNR.
**Evaluation method**

Each time the subjects received EASNR, the severity of low back pain, lower extremity pain and lower extremity dyseaesthesia were evaluated before and directly afterwards using a numerical scale, with 10 indicating the severity of pain or dyseaesthesia prior to receiving EASNR at the first consultation, and 0 indicating complete absence of symptoms. Subjects were also asked how long the effect continued after EASNR. Patients with spinal claudication were asked to walk before and directly after EASNR, and the walking distance was recorded. Of the three subjects, two had undergone SNB treatment (with the aim of delivering local anaesthetics into the intervertebral foramen as both a therapeutic and diagnostic procedure) before receiving EASNR. The effectiveness of SNB was evaluated using the same outcomes.

**Results and Course**

Case 1  Directly after EASNR, low back pain score decreased from 10 to 1, while lower extremity pain and lower extremity dysaesthesia decreased from 10 to 2. Extended walking distance increased from 50m to 300m. When the patient reattended hospital two weeks later, low back pain, lower extremity pain and lower extremity dysaesthesia were all still scored at 2, and the increase in extended walking distance of 50m to 300m was maintained, indicating the sustained effectiveness of the EASNR. Following further EASNR, low back pain score decreased 1, as did lower extremity pain and lower extremity dysaesthesia. At the last evaluation, 12 months after the second EASNR, there has been no clear recurrence of symptoms, and extended walking distance is now maintained at over 500m.

Case 2  Directly after EASNR, the evaluation of low back pain, lower extremity pain and lower extremity dysaesthesia decreased from 10 to 2. With regard to spinal claudication, walking distance increased from 50m to 150m. However, with this patient, symptoms recurred two days after EASNR, and finally a laminectomy at L4/5 was performed. After the operation, low back pain, lower extremity pain and lower extremity dysaesthesia had disappeared, and walking distance increased to over 500m. Low back pain, lower extremity pain and lower extremity dysaesthesia recurred four months after the operation. SNBs were performed at L5 and S1 twice, but their effectiveness lasted for just three or four days. Therefore, L5 and S1 EASNR was conducted once every two weeks for a total of six sessions. Directly after each of these treatments, evaluation of low back pain, lower extremity pain and lower extremity dysaesthesia decreased from 10 to 0, 10 to 1 and 10 to 2 respectively, and these improvements were sustained for 7 to 14 days.

Case 3  After the first SNB, symptoms reduced from 10 to 6; after the second, from 10 to 7, and on each occasion the effect lasted only one day. Directly after the first and only treatment with EASNR, low back pain, lower extremity pain and lower extremity dysaesthesia decreased from 10 to 0, while walking distance increased from 100m to 200m. At last assessment four months after the EASNR, there had been no recurrence of symptoms, and walking distance had increased to over 500m.

**Discussion**

Selective SNB was first reported by Macnab in 1971. At present it is used both to assist the diagnosis of the specific spinal nerve lesion and as a method of treatment, and it has been reported widely. In selective SNB it is thought that injection of local anaesthetic blocks the affected sensory nerve and sympathetic nerve to alleviate pain and improve blood flow. When corticosteroids are also used, there is also thought to be a direct anti-inflammatory action on the nerve root.

With the three cases reported here, selective SNB had been used unsuccessfully to treat radicular sciatica, and subsequently low frequency EASNR was performed. As a result, in all three cases there was a marked reduction in the root symptoms directly after EASNR together with increased walking distance. In addition, long-term effects were observed in two of the cases.

We originally thought that EASNR would act on lower extremity pain by activating descending inhibitory control, and inhibitory control at the spinal level, the mechanisms of regular acupuncture analgesia. However, the results in this
paper indicate that in addition to lower extremity pain, the EASNR reduced lower extremity dysaesthesia and increased walking distance, as well as providing a long-lasting effect. It is thought that claudication associated with spinal canal stenosis, results from pressure on the cauda equina with restriction of blood flow. This in turn leads to a dramatic reduction in the ability to meet the oxygen demands of the nerves controlling the lower extremities during walking. With regard to the relationship between spinal claudication and blood supply to nerve tissue, we have previously demonstrated that acupuncture stimulation in the lumbar area,9 electrical stimulation of the sciatic nerve,9 and electrical stimulation of the pudendal nerve in the rat cause a transient increase in nerve blood flow.10 In light of this, we believe that increased nerve blood flow from stimulation plays a major role in the effects of acupuncture and low frequency EA on spinal claudication. Thus, we believe that direct stimulation of the nerve root with EASNR results in increased nerve blood flow, which reduces lower extremity dysaesthesia and increases walking distance, and the effect appears to be sustained. With the EASNR conducted in this study, it is thought that, because referred pain in the innervation area of the nerve root, together with muscle contraction, can be confirmed during the procedure, thereby enabling precise electrical acupuncture at the desired nerve root, direct low frequency EASNR participates in changes to the circulatory dynamics of the sciatic nerve including the cauda equina and spinal nerve root.

In case 2, no long term effect was obtained, but it was significant that one EASNR treatment every two weeks achieved control of the root symptoms, and it is possible that in cases in which surgery is not possible, EASNR could be an effective option for treating cases that do not respond well to SNB.

In the two cases that had undergone SNB before receiving EASNR, the effect directly after EASNR, and the effect duration, were more pronounced than the effect and duration provided by SNB. It is thought that one reason for this is that in cases of chronic radicular sciatica and intermittent claudication associated with the reduced nerve blood flow, the stimulating treatment of EASNR raises nerve blood flow more effectively than the local anaesthetic injection of SNB. The analgesic mechanisms of SNB and EASNR are also likely to be different, and it is thought that stimulation treatment may be more effective than anaesthetic treatment in some circumstances, depending on the pathology, stage, symptoms and other factors.

Although the results in these three cases were promising, further study of this treatment technique is required in different centres before general conclusions can be drawn.

Reference list
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