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Controlling Herpes Zoster-Associated Pain Using an Electrical Stimulating Catheter with a Steering Guidewire: A Case Series

Seong Soo Hong[1], Dae Hee Suh[1], Eun-ha Choi[1], Jung Eun Kim[1*], Sung Jun Hong[2]

[1]Department of Anesthesiology and Pain Medicine, Kangnam Sacred Heart Hospital, Hallym University College of Medicine, Seoul, Korea
[2]Department of Anesthesiology and Pain Medicine, Kangdong Sacred Heart Hospital, Hallym University College of Medicine, Seoul, Korea

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***Corresponding author:** Jung Eun Kim, MD, PhD

Abstract **Case Report**

Background: Treatment of herpes zoster not only includes antiviral therapy but also treatment of herpes zoster-associated pain. Severe herpes zoster-associated pain often limits a patient's activities of daily living and may significantly lower functional status and quality of life. It also functions as an important predictor of postherpetic neuralgia. Thus, effective treatment of zoster pain is highly necessary. The effectiveness of a drug may depend on the method of administration, with each route having merits and limitations. Accurate epidural drug delivery directly into an affected spinal segment can maximize the effects of the drug, while minimizing systemic adverse drug effects. Here, we present three cases of successful control of zoster pain using an electrical stimulating catheter with a steering guidewire. ***Case Presentation***: We treated three patients suffering from herpes zoster with continuous segmental block using an electrical stimulating catheter. The first case involved a 54-year old man with severe right-sided low back and thigh pain, the second patient was a 72-year-old woman suffering from multiple painful grouped vesicles on the left flank, the third patient was a 72-year-old man with multiple vesicles on the right arm. The three patients were treated with continuous segmental block via an electrical stimulating catheter, which was able to localize stimulation to the affected spinal segment. There were no procedure-related complications, and the pain levels of the patients decreased significantly. ***Conclusions***: Continuous segmental block through electrical stimulation using an electrical stimulating catheter with a steering guidewire can be precisely positioned, providing targeted drug delivery and effective management of herpes zoster.

Keywords: Electrical stimulating catheter, Herpes zoster, Specific segmental analgesia, Zoster pain.

BACKGROUND

Herpes zoster is a disease caused by reactivation of latent varicella-zoster virus in trigeminal and dorsal root ganglion. Although herpes zoster is not a fatal disease, it can cause severe zoster pain including both acute zoster pain and chronic pain of postherpetic neuralgia.

Zoster pain results from viral damage and increased sensitization of sensory neurons in the affected segment [1]. The reactivated virus destroys the affected central and peripheral nerves and leads to inflammation, immune response, and neuronal loss to varying extents within affected spinal ganglia [2, 3]. Severe zoster pain can cause physical disability, emotional distress, and impaired quality of life [4, 5]. Furthermore, the severity of acute zoster pain is arisk factor for postherpeticneuralgia [6].Therefore, effective treatment for zoster pain is crucial.

Epidural drug administration into an affected spinal segment is superior to oral drug administration [7]. Accurate epidural drug delivery into an affected spinal segment can maximize the effects of the drug while minimizing systemic adverse drug effects by delivering therapeutic agents directly into the targeted spinal segment without gastrointestinal absorption and first-pass hepatic metabolism [8]. In addition, drugs administered via the epidural route can penetrate the blood-brain barrier more easily than drugs administered orally.

It is extremely important to verify the exact lesion and place the block needle or catheter correctly into the epidural space adjacent to the lesion when

using epidural analgesia for treating lesions of specific spinal segments, such as those found in zoster [9]. Unfortunately, there is currently no specific device for accurate epidural drug delivery into the affected spinal segment alone. Here, we implemented an electrical stimulating epidural catheter with a steering guidewire (EpiStim®, Sewoon Medical Co., Ltd, Seoul, Korea) to provide continuous epidural analgesia for the treatment of severe zoster pain that was unresponsive to conventional oral medications. The catheter typically used for epidural neuroplasty, can verify the lesion by electrical stimulation and can be placed into the epidural space exactly at the level of a specific spinal segment by the steering guidewire. In a similar way, it is can be used to confirm the exact location of the catheter tip when performing a continuous brachial plexus block [10]. We obtained good results in the management of severe zoster pain using the catheter, without any complications.

CASE PRESENTATION

Case 1

A 54-year-old male patient presented at the dermatology department of Korea University Hospital with severe right-sided low back and thigh pain, accompanied by a skin rash with multiple clustered vesicles of right low back and anterior thighthat had appeared 7 days prior to the examination. For 5 days, the patient had received famciclovir 750mg/day, gabapentin1,800mg/day, and ibuprofen 600mg/d, codeine 30mg/d, acetaminophen750mg/day via oral administration at the Dermatology Department, but the pain worsened and the patient was subsequently admitted to our pain clinic via the emergency room. The pain was continuous, sharp, and lancing, and it originated from the L2 or L3 dermatome. The patient's pain scored 10 (worst pain possible) on the visual analog pain scale (VAS). His pain was so severe we planned continuous caudal segmental analgesia using an electrical stimulating epidural catheter to target the affected spinal segment in order to control the patient's severe zoster pain.

The patient was given 1 g of cefazolin intravenously prior to the procedure. He was placed on the procedure table in the prone position. Supplemental oxygen was delivered through a nasal cannula, and blood pressure measurement, electrocardiography, and pulse oximetry were performed throughout the procedure. The skin was prepped with 2% alcohol-chlorohexidine and draped sterilely. Lidocaine (1%) was used for local anesthesia at the puncture site, and the epidural needle was inserted into the epidural space via the sacral contrast media, the catheter was inserted through the epidural needle with the aid of the bent conductive guidewire, and electrical nerve stimulation was applied by a peripheral nerve stimulator. The intensity of the electrical stimulation was gradually increased until the affected dermatome was stimulated. In this case, the effects were observed after L3 root stimulation and matched the zoster pain at the site; the minimum responsive stimulation intensity was 0.5 mA. After confirming the correct placement at the L3 segment using contrast medium, an indwelling catheter was placed (Fig 1). We injected contrast medium prior to injection of the solution containing particulate steroid in order to prevent the drug from entering the blood vessel. After confirming the placement, 7.5 mg ropivacaine (0.19% weight/volume) and 2 mg dexamathasone were administered, followed by continuous infusion of 275 cc 0.1% ropivacaine at a rate of 4 cc per hour. After completion of the procedure, hypesthesia in the relevant dermatome was detected. The patient was examined for any procedure-related complications and was kept under observation for about an hour. There were no complications related to catheter insertion, and the patient's pain level reduced to VAS 6 after the procedure.

The continuous spinal segmental analgesia was maintained for 14 days. The patient received intravenous acyclovir (500 mg/day) during the first 6 days along with gabapentin 1800 mg/day, and 10 mg/day amitriptyline.12 days after the insertion of the catheter, the patient's pain level had decreased and stabilized at VAS 3. Two weeks later, after removal of the catheter, the patient's pain was at VAS 2, and 2 months later, the patient's pain was completely disappeared.

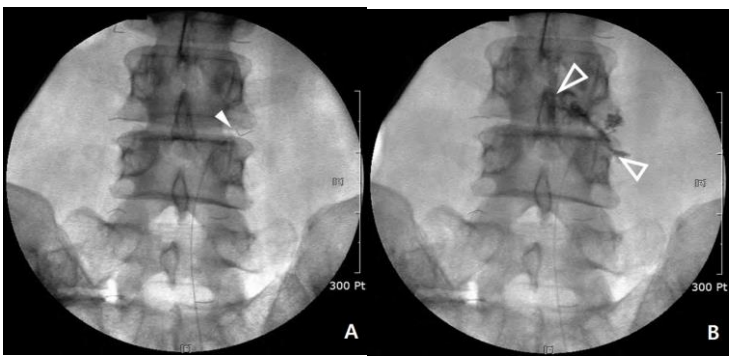

Fig 1: Specific lumbar spinal segmental analgesia using an electrical stimulating catheter with a steering guidewire. (A) The catheter tip is located at the right L3 nerve root(white filled triangle).Affected L3 dermatomal lesion was verified by concordant paresthesia to the area of zoster pain with electrical epidural stimulation. (B) This figure shows contrast spread along the nerve root (white empty triangle) as well as epidural space

Case 2

A 72-year-old female patient presented to the pain clinic 5 days after the onset of multiple painful clustered vesicles on the left flank. The flank pain originated from the T6 or T7 dermatome and the patient described it as a severe (VAS 8), sharp, lancing pain occurring every 3–4 min. The patient had received famciclovir 750mg/day, gabapentin 900mg/day, codeine 60mg/day, and acetaminophen 1950mg/day via oral administration, but the pain was not relieved. The patient had undergone kyphoplasty at T7 and T8 for vertebral compression fractures 1 month previously.

Prior to the procedure, the patient was prepared as described for case 1. An epidural needle was advanced into the epidural space at the T10/11 intervertebral space and needle placement was confirmed by C-arm images. The catheter was then inserted through the epidural needle and guided to the T6 and T7 left root sleeve using electrical nerve stimulation. After the pain was reproduced at the lesion upon stimulation of the T7 root at a minimum responsive stimulation intensity of 0.5 mA, contrast media was distributed through the T7 segment to confirm the placement. A single bolus of 4 mL of 0.19% ropivacaine and 2 mg dexamathasone was administered through the fixed epidural catheter, followed by a continuous infusion of 275 cc 0.12% ropivacaine at a rate of 4 cc per hour. There were no complications related to catheter insertion, and the patient's pain level reduced to VAS 4 after the procedure.

The continuous thoracic segmental analgesia was maintained for 14 days after the procedure. The patient also received 750 mg/day of oral famciclovirduring the first 7 days and 900 mg/day gabapentin and 5mg amitriptyline during the treatment period. Subsequently, the patient's pain was within VAS 2–4, and after approximately 1 month, the pain had decreased to VAS 2.

Case 3

A 72-year-old male patient presented with a chief complaint of multiple clustered vesicles on the right arm, with pain at the lateral portion of the right upper arm, forearm, hand, thumb, and index finger during the previous month. The patient had been treated at another hospital, but felt that the pain was not adequately controlled. The patient described it as a continuous lancing and tingling pain at VAS 5.

When he visited our pain clinic for the first time, he refused the continuous epidural block. The patient received antiviral therapy (famciclovir, 750 mg/day) along with 900 mg/day gabapentin, 10 mg/day amitriptyline, and 20 mg/day oxycontin, but the pain was not controlled and worsened to VAS 7. Therefore, continuous cervical segmental analgesia was recommended.

The procedure was performed as in case 1 and 2. After electrical nerve stimulation, the pain was reproduced at the site of the lesion upon stimulation of the C6 root and the spread of contrast media through the C6 segment was observed (Fig 2). A single bolus of 4 mL of 0.19% ropivacaine and 2 mg dexamathasone was administered through the fixed epidural catheter, followed by a continuous infusion of 0.11% ropivacaine at 4 cc per hour. There were no complications related to catheter insertion, and the patient's pain level reduced to VAS 4 after the procedure. Continuous cervical segmental epidural analgesia was maintained for 14 days after the procedure. The patient is under outpatient follow-up, with a pain level that is currently stable at around VAS 2.

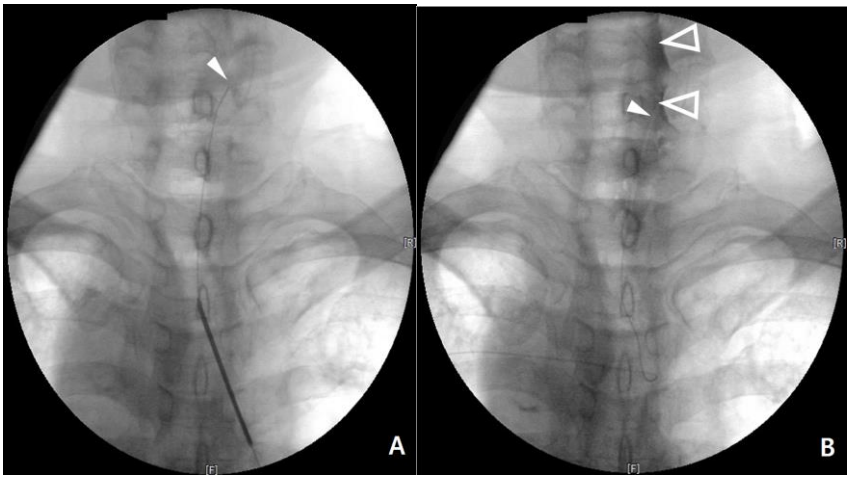

Fig 2: Specific cervical spinal segmental analgesia using an electrical stimulating catheter with a steering guidewire.(A) The catheter tip is located at the right C6 nerve root (white filled triangle). Affected C6 dermatomal lesion was verified by concordant paresthesia to the area of zoster pain with electrical epidural stimulation. (B) This figure shows contrast spread along the nerve root (white empty triangle) as well as epidural space.White filled triangle indicates the epidural catheter tip placed at C6 nerve root

DISCUSSION

The zoster virus generally invades a single spinal segment and causes pain by damaging the dorsal root ganglion, spinal nerve, peripheral nerve, and skin [11]. Management of zoster pain is frequently a challenging clinical problem. Some severe zoster pain is difficult to manage with conventional painkillers. Therefore, we postulated that severe zoster pain that is refractory to conventional painkillers is a good clinical subject for evaluating the efficacy and safety of specific segmental epidural analgesia. Furthermore, we also postulated that the analgesia can have positive effect on preventing postherpetic neuralgia. Althoughthere is no general consensus about standard treatment preventing PHN, but many studies have emphasized the need of early treatment and intensive treatment that can prevent the PHN [12]. Adding on to conventional treatment such as vaccination and medical treatment, neuraxial block could be an effective treatment option in preventing PHN [13-15].

Although oral drug administration is the most popular route for medication, with a high degree of convenience and compliance, it has several limitations, such as bioavailability and adverse drug effects due to many biological barriers [16]. Many drugs cannot be effectively delivered via the oral route due to limited gastrointestinal absorption and first-pass hepatic metabolism [17, 18]. However, drug dosage cannot be increased to an unlimited extent in order to overcome the limitations of this route due to adverse effects including drug interactions. Drug efficacy and adverse drug effects dose-dependently determine the clinical outcome of a medication. A higher dose boosts the drug's therapeutic effect, but simultaneously increases the propensity for undesirable adverse drug effects [8]. We postulated that the limitations of oral drug administration can be overcome by specific segmental epiduralblock in severe acute zoster pain.

Epidural block is a significant medical innovation of the past century [19]. It has allowed administration of drugs directly to the nerves and peripheral tissues via the epidural space, which extends from the base of the skull to the sacral hiatus and the sacrococcygeal ligament, and is composed of fatty tissue, loose connective tissue, lymphatics, arteries, veins, and segmental nerve roots that traverse its lateral boundaries [20]. Epidural drug administration is a good choice for overcoming the limitations of oral drug administration, such as low bioavailability or the increased likelihood of systemic adverse drug effects in the treatment of lesions of intra-spinal structures, such as the nerve roots or the spinal cord [21]. Furthermore, targeting epidural drug administration into the restricted lesion of a specific spinal segment can reduce the amount of analgesics required as compared with conventional epidural analgesia.

It is crucial to verify the exact lesion and to administer analgesics accurately into the specific spinal segment for successful epidural analgesia in lesions of specific spinal segments. The catheter is an electrical stimulating epidural catheter with a steering guidewire. The catheter has an end-hole with a conductive 25° bent tip guidewire inside the lumen. The catheter can deliver electrical stimulation into the spinal nerve through the conductive guidewire by means of a peripheral nerve stimulator. The catheter advances in the direction of the bent tip in the epidural space. The catheter can also be placed exactly into the epidural space adjacent to the targeted lesion in a specific spinal segment by steering the catheter.

We were able to verify the lesions exactly and place the catheter correctly into the epidural space adjacent to the lesions of those specific spinal segments and thereby manage the zoster pain in patients who were unresponsive to conventional oral painkillers. This was done without any complications, using an electrical stimulating epidural catheter, with a smaller dose of local anesthetic than used in conventional epidural analgesia.

Specific segmental epidural analgesia using an electrical stimulating catheter is a novel technique for zoster pain management. This case series is the first report that verified the exact dermatomal lesion by electrical nerve stimulation and delivered drugs accurately into a restricted lesion of the specific spinal segment. Although further research is required to optimize the intensity of electrical stimulation, the dosage and volume of the injected drug for covering one spinal segment, we believe that specific segmental epidural drug administration can be a good choice for the treatment of a restricted lesion in a specific spinal segment.

We plan on conducting a prospective study on specific segmental epidural analgesia using an electrical stimulating catheter for delivery of analgesia and antiviral agents in the future. We hope that this study will inspire other researchers to verify the efficacy and safety of this specific segmental epidural injection technique for the treatment of herpes zoster.

CONCLUSION

In conclusion, the authors successfully managed severe zoster pain that was refractory to conventional oral medication by specific segmental epidural analgesia by using an electrical stimulating catheter with a steering guidewire. Our experience indicates that specific segmental epidural analgesia can be used effectively for the management of zoster pain refractory to conventional oral painkillers.

Consent

Written informed consent was obtained from the patient for publication of the case report.

List of abbreviations: VAS: Visual analog pain scale

Competing interests: The authors declare that they have no competing interests.

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