CLINICAL ARTICLE

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Radiofrequency Neurotomy of the Gray Ramus Communicans for Lumbar Osteoporotic Compression Fracture

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Objective : The aim of this study was to determine the efficacy of percutaneous radiofrequency neurotomy(RFN) of gray ramus communicans nerve in patients suffering from severe low back pain due to osteoporotic compression fracture.

Methods : Twenty two patients with lumbar osteoporotic compression fracture who had intractable back pain for less than two weeks and were performed with RFN at L1-L4 from May 2004 to December 2005 were retrospectively analyzed. Clinical outcome using visual analogue scale(VAS) pain scores and modified MacNab's grade was tabulated. Complications related to the procedure were assessed.

Results : Twenty-two female patients (age from 63 to 81 years old) were included in this study. The mean VAS score prior to RFN was 7.8, it improved to 2.6 within postoperative time of 48 hours, and the mean VAS score after 3 months was 2.8, which was significantly decreased. Eighteen of 22 patients were graded as excellent and good according to modified MacNab's criteria at final follow up. All patients recovered uneventfully, and the neurologic examination revealed no deficits. Two patients showing poor results worsened in symptom. Percutaneous was performed eventually resulting in symptom improvement. There were no significant complications related to the procedure such as sensory dysesthesia, numbness or permanent motor weakness.

Conclusion : RFN is safe and effective in treating the painful osteoporotic compression fracture. In patients with intractable back pain due to lumbar osteoporotic compression fracture, RFN of gray ramus communicans nerve should be considered as a treatment option prior to vertebroplasty.

KEY WORDS : Osteoporosis. Compression fracture · Radiofrequency neurotomy · Gray ramus communicans.

Introduction

With the rapid increased rate of aging populations, patients with osteoporotic compression fractures are increased as well, and thus, quality of life is lowered[3]. Percutaneous vertebroplasty or kyphoplasty has become an established technique for the treatment of painful osteoporotic compression fractures. But reported significant complication after vertebroplasty include increased pain, radiculopathies, spinal cord compression, infection, rib fractures and pulmonary embolism. Also, there is the problem of getting no coverage from insurance when vertebroplasty is performed within 2 weeks of injury[5]. The ramus communicans nerve innervates the vertebral body, and denervation of this nerve can be used to treat pain in vertebral compression fractures related to osteoporosis, as reported by Chandler et al.[2] We herein report our experience of RFN of ramus communicans for the treatment of painful osteoporotic compression fracture.

Materials and Methods

Participants for this study were recruited from a group of patients with osteoporotic compression fracture who had severe low back pain for less than two weeks of injury. Mean T-score was -3.72 in bone marrow densitometry(BMD). These patients had no response to conservative treatment, which included all type of medication or epidural block and, refused percutaneous vertebroplasty. We also excluded the patients

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who had cancer history or who had severe cord compression. Prior to and after RF neurotomy, the patients degree of pain was recorded by using the visual analog scale method (a scale of 0~10, with 10 indicating the most pain). After the procedure, patients were asked according to modified MacNab's criteria whether their pain was completely relieved (excellent), partially relieved (good), unchanged, or worse (poor).

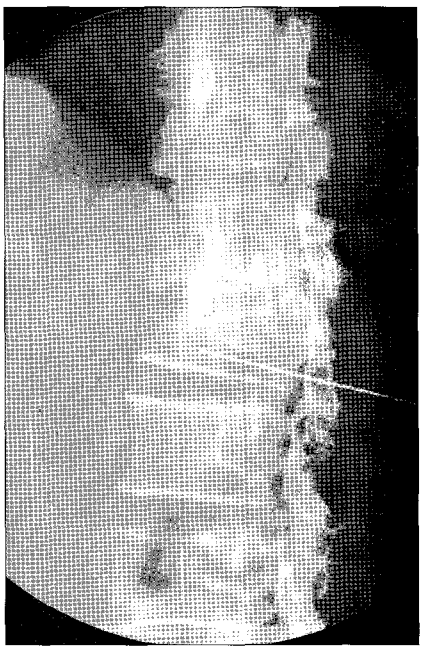

Fig. 1. Oblique radiograph shows the RF cannula position for lesioning of the ramus communicans nerve.

Fig. 2. Lateral radiograph demonstrates the RF cannula position for lesioning the posteroinferior third aspect of the verterbral body.

Radiofrequency lesioning procedure

With the patients prone on the operating table, C-arm fluoroscopy was directed cranially or caudad so that the end plates of the intervertebral disc and the vertebral body could be well visualized. The fluoroscope was then positioned at a 10° to 20° oblique angle, with the position adjusted until the lateral tip of the transverse process and the anterior margin of the vertebral body were in alignment. The skin and subcutaneous tissue overlying the entry point were anesthetized with 2% lidocaine. A 150mm RF curved cannula (cannula 415/10mm, Stryker Leibinger GmbH&Co. KG, Freiburg, Germany) with a 10mm active tip was introduced at the caudad third aspect of the vertebral body, parallel to the fluoroscopic beam, and advanced until the peritoneum was contacted (Fig. 1). At this point, the cannula was advanced until it was positioned at just inferior to pedicle, 5~10mm anterior to foramen and the lateral third aspect of the vertebral body under lateral fluoroscopic view (Fig. 2). With the tip of the cannula in proper position, the stylet was replaced by RF probe and then connected to the RF thermocoagulator (Neuro N50, Leibinger GmbH & Co. KG, Freiburg, Germany). Electrostimulation was applied at 50Hz, 0.8~1.0 volt. The location that provoked a deep aching pain identical to the usual pain of the patient was confirmed. After a point at which no motor stimulation of the lower extremity was noted with a 2Hz, 1.0~3.0 volt stimulation, RF thermocoagulation was performed at 80°C for 90 seconds. If motor stimulation was seen, we adjusted the tip of the RF cannula until there was no stimulation of motor portion of the nerve roots, RF cannula was gently redirected underneath the pedicle the rest slightly anterior to the superior aspect of the intervertebral foramen. The cannula should be 0.5cm anterior to the foramen, from the fluoroscopic anteroposterior(AP) view, it should be at the lateral portion of the vertebral body as evidenced by fluoroscope. After RF thermocoagulation, 2ml of preservative-free 1% lidocaine (Xylocaine®, Astra Co., Korea)was injected along with 40mg of sterile triamcinolone acetonide (Tamcetone®, Hanol Inc., Korea) for the purpose of preventing postoperative neuritis. Statistical analysis of pre- and postoperative scores for the severity of pain was performed using chi-square & paired t-test. P value less than 0.05 was considered as statistically significant.

Results

Twenty-two female patients (age from 63 to 81 years old) were included in this study. Involved vertebrae were located from levels L1 to L4. The levels were L1 (n=12), L2 (n=5), L3 (n=3), and L4 (n=2). The follow-up period was at least 4 months. The mean VAS score prior to RFN was 7.8, it improved to 2.6 within postoperative time of 48 hours, and the mean VAS score after 3 months was 2.8, which was significantly decreased ($p<0.005$) (Table 1). Eighteen of 22 patients were graded as excellent and good according to modified MacNab's criteria at final follow up (Table 2). Two patients showing poor results worsened in symptom. One patient complained of constant pain and the other patient showed

Table 1. Comparison of variables before and after the RFN

	Before RFN	48 hours after RFN	3 months after RFN
VAS pain score	7.8±2.1	2.6±1.2	2.8±1.4*

(*$p<0.005$), Values are mean ±SD, RFN : Radiofrequency neurotomy, VAS : Visual analogue scale

Table 2. Modified MacNab outcome assessment of patient satisfaction with the surgical procedure at final clinical follow-up

Outcome	Description of criteria	Number of patients
Excellent	No pain; no restriction of mobility; return to normal work & level of activity	12
Good	Occasional nonradicular pain; relief of presenting symptoms; return to modified work	6
Fair	Some improved functional capacity; still handicapped and unemployed	2
Poor	Continued objective symptoms of root involvement; additional operative intervention needed at the index level irrespective of length of postoperative follow-up	2

progressive compression and aggravation of kyphosis. So, vertebroplasty was performed eventually resulting in symptom improvement. Another one patient complained of mild lower limb weakness, but she completely recovered at postoperative 7 days without any serious sequelae.

Discussion

Percutaneous vertebroplasty is currently indicated for palliative therapy for pain that is medically uncontrolled osteoporotic compression fracture. The specific contraindications to the procedure have previously been stated as being significant spinal canal compromise, severe collapse of the vertebral body (vertebra plana), active infection and in some cases fractures involving the posterior vertebral body cortex[5-7]. Reported significant complication related to vertebroplasty include increased pain, radiculopathies, spinal cord compression, infection, rib fractures and pulmonary embolism. Also, there is the problem of getting no coverage from insurance when vertebroplasty is performed within 2 weeks of injury[5]. Many studies have described the annulus fibrosus of intervertebral disc and vertebral body have diverse innervation[4,10]. The dorsal aspect of the annulus fibrosus and the posterior longitudinal ligament are innervated by the sinuvertebral nerve, a branch of the anterior spinal nerve; the dorsal and lateral side is innervated by other branches of the anterior spinal nerve; the ventral and lateral side is innervated by branches of the ramus communicans nerve that connect the spinal nerve and the sympathetic trunk. The ramus communicans nerve branches from the spinal nerve just after it enters the intervertebral foramina connected to the sinuvertebral nerve. it runs anteriorly at the inferior third aspect of the vertebral body, and connects to the sympathetic trunk before branching to the lateral and lateroanterior aspects of the discs above and below[1,9]. The ramus communicans nerve innervates the vertebral body, and denervation of this nerve can be used to treat pain in vertebral compression fractures related to osteoporosis, as reported by chandler et al.[2] Radiofrequency thermocoagulation, used to block the ramus communicans nerve, has also been used for posterior structures of the spine : the facet joint, the sacroiliac joint, the medial branch of the posterior primary division, and the dorsal root ganglion, Anterior structures of the spine, however, have not been considered significant in the treatment of back pain, and, because the innervations are composed of networks, applications for RF thermocoagulation are limited. Because RF thermocoagulation is becoming more advanced and it is now possible to regulated the heat to allow selective coagulation of thermally sensitive unmyelinated nerve fibers, and because more clinical data are now available on spinal pain, this technique now appears feasible for anterior structures of the spine. Although the ramus communicans nerve usually runs internally to the psoas muscle, it can run within the connective tissue of the disc and the psoas muscle due to anatomic variance.

Therefore, in the procedure used in this study, the catheter was placed at the posterior lateral third aspect of the spine. Additional caution is necessary because thermal damage may occur to the nerve root as a result of its close proximity to the catheter. To minimize the possibility of this complication, we ensured that there were no muscle contractions of the lower limbs with 2Hz, 2 volts stimulation, showing that the motor nerve was not within 3mm of the catheter. The possible complications following RF lesioning include mild to severe neuritis, numbness, and transient dysesthesia and weakness on the affected limb.

Transient dysesthesia usually abate within 2 weeks. One patient complained of mild lower limb dysesthesia and weakness. He completely recovered at postoperative 7 days without any serious problems, probaly due to a reversible thermal nerve root injury.

However, the sample size of this study is inadequate to study the statistical significance rate of complications related to RF lesioning. Vessel injury must also be prevented. As with any invasive procedure, infection and bleeding are possible complications. In conclusion, patients experienced satisfactory pain relief after RFN of the ramus communicans nerve, which is a safe, uncomplicated procedure for the treatment of intractable pain for lumbar osteoporotic compression fracture. But further investigations including a more rigorous selection of patients with osteoporotic compression fracture and long term follow up are thought to be needed.

Conclusion

RFN is safe and effective in treating the painful osteoporotic compression fracture at lumbar region. In patients with intractable back pain due to osteoporotic compression fracture, RFN of ramus communicans nerve should be considered as a treatment option prior to vertebroplasty.

References

1. Bogduk N, Tynan W, Wilson AS : The nerve supply to the human lumbar intervertebral discs. **J Anat 132 (Pt 1)** : 39-56, 1981
2. Chandler G, Dalley G, Hemmer J Jr, Seely T : Gray ramus communicans nerve block : novel treatment approach for painful osteoporotic vertebral compression fracture. **South Med J 94** : 387-393, 2001
3. Deramond H, Depriester C, Galibert P, Le Gars D : Percutaneous vertebroplasty with polymethylmethacrylate. Technique, indications, and results. **Radiol Clin North Am 36** : 533-546, 1998
4. Jackson HC 2nd, Winkelmann RK, Bickel WH : Nerve endings in the human lumbar spinal column and related structures. **J Bone Joint Surg Am 48** : 1272-1281, 1966
5. Kim SW, Lee SM, Shin H, Kim HS : Percutaneous vertebroplasty following postural reduction in unstable vertebra plana; is it a contraindication? **J Korean Neurosurg Soc 39** : 92-95, 2006
6. Peh WC, Gilula LA, Peck DD : Percutaneous vertebroplasty for severe osteoporotic vertebral body compression fractures. **Radiology 223** : 121-126, 2002
7. Peters KR, Guiot BH, Martin PA, Fessler RG : Vertebroplasty for osteoporotic compression fractures : current practice and evolving techniques. **Neurosurgery 51 (5 Suppl)** : 96-103, 2002
8. Phillips FM, Todd Wetzel F, Lieberman I, Campbell-Hupp M : An in vivo comparison of the potential for extravertebral cement leak after vertebroplasty and kyphoplasty. **Spine 27** : 2173-2178, 2002
9. Suseki K, Takahashi Y, Takahashi K, Chiba T, Yamagata M, Moriya H : Sensory nerve fibers from lumbar intervertebral discs pass through rami communicantes. A possible pathway for discogenic low back pain. **J Bone Joint Surg Br 80** : 737-742, 1998
10. Yoshizawa H, O'Brien JP, Smith WT, Trumper M : The neuropathology of intervertebral discs removed for low-back pain. **J Pathol 132** : 95-104, 1980