CLINICAL ARTICLE

J Korean Neurosurg Soc 40: 95-98, 2006

Radiofrequency Neurotomy for Remnant Pain after Vertebroplasty as the Treatment of Severe Compression Fracture

Saeng Youp Kim, M.D., Seok Won Kim, M.D.

Department of Neurosurgery, College of Medicine, Chosun University, Gwangju, Korea

Objective : The aim of this study is to evaluate the feasibility, safety and effectiveness of radiofrequency neurotomy(RFN) for remnant pain after vertebroplasty for the treatment of severe compression fracture.

Methods : 25 patients with remnant pain after vertebroplasty for one level severe compression fracture were treated by RFN. The severe compression fractures were defined to the vertebrae which less than 50% of their original heights have collapsed. Pain relief was evaluated at 2 weeks, 6 weeks and 3 months after the procedure using a visual analog scale(VAS).

Results : Successful outcome was determined if pain reduction exceeded 50% on the VAS at 6 weeks. Six of the 25 patients did not respond favorably to RFN (pain reduction less than 50%), and nineteen patients showed successful responses. Mean VAS score was decreased from 5.48 to 2.96 at 6 weeks.

Conclusion : The radiofrequency neurotomy may be both feasible and useful treatment for the remnant pain after vertebroplasty. However long-term follow up is needed to confirm the effectiveness.

KEY WORDS : Severe compression fracture · Vertebroplasty · Remnant pain · Radiofrequency neurotomy.

Introduction

Percutaneous vertebroplasty(PV) has emerged as an effective treatment for the painful osteoporotic compression fracture[1,2]. However, for the cases of compression fractures, although vertebroplasty may result in relief of symptoms, patients often experience remained pain along the margins of ribs.

The purpose of this study is to determine the efficacy of radiofrequency neurotomy(RFN) for the remnant pain after vertebroplasty in treating severe osteoporotic compression fractures with greater than 50% loss of their original heights.

Materials and Methods

In 212 consecutive patients, 298 percutaneous vertebroplasties were performed in our institute from January 2003 to August 2004. Among them, 25 women (mean age 67.8 years) underwent radiofrequency neurotomy for remnant pain after vertebroplasty to treat severe osteoporotic compression fractures. Severe vertebral compression fractures were defined as vertebrae that had collapsed to less than 50% of their original height on lateral radiographs.

These patients had not responded to conservative treatments, which included all types of medication. Vertebroplasty had been performed at only one level in all patients. Prior to and after RFN, the patient's degree of pain was recorded by using the visual analog scale(VAS) method (1 scale of 0-10, where 10 indicates the most pain). The mean VAS scores for before and after vertebroplasty therapy were compared. The pain relief was estimated at 2 weeks, 6weeks and 3 months after the RFN.

On the radiolucent operative table, with each patient in a prone position, the C-arm fluoroscopy was adjusted to an A-P view, so that the superior and inferior margin of the vertebral body were merged as a single line. Subsequently, the imaging intensifier was rotated approximately 10~15 degrees to detect the pedicle more appropriately. Under X-ray inspection, a 22 guage with 5mm active tip and 100mm cannula (SMKC10 needle) were inserted toward Burton's point where the superior articular process and transverse process meet. On the lateral radiopraphy, its accurate location was confirmed. Subsequently,

• Received : December 13, 2005 • Accepted : June 5, 2006

• Address for reprints : Seok Won Kim, M.D., Department of Neurosurgery, College of Medicine, Chosun University, 588 Seoseok-dong, Dong-gu, Gwangju 501-717, Korea Tel : +82-62-220-3120, 3126, Fax : +82-62-227-4575, E-mail : chosunns@hanmail.net

the probe was removed from the cannula and an electrode was inserted. High frequency thermal coagulation instrument (N50R, Leibinger, Germany)was connected to assess the sensory reaction. First, it was conducted under 50Hz, 0.2~0.4 volts. Then Electric stimulation was confirmed by increasing gradually up to a maximum of 0.8~1.0 volts, in which burning dysesthesia was assessed. To evaluate the motor reaction, after the increase of the voltage to 2Hz, 0.8 volts gradually, the fasciculation of the multifidus muscle controlled by the medial branch of posterior primary ramus was observed, and once the fasciculation was confirmed, the voltage was raised to 3 volts. It was confirmed that the fasciculation did not occur in the muscles of lower limbs, and the lesion was made 80℃ for approximately 90 seconds. After the formation of the lesion, to prevent discomfort and the development of neuritis, 0.5ml 1% lidocaine and 5mg triamcinolone acetonide (TamcetoneR, Hanol Inc., Korea) per lesion were administered and the surgical procedure was completed.

Table 1. Results of radiofrequency neruotomy for remnant pain after vertebroplasty

Patient number	Sex/ age	Compression fracture level	VAS change				
			Before vertebroplasty	After Vertebroplsty & Before RFN	After 2weeks RFN	After 6weeks	After 3months
1*	F/65	T12	9	6	4	2	4
2	F/59	L1	8	5	3	2	2
3*	F/62	L1	8	5	4	4	4
4	F/72	T12	8	5	3	2	1
5	F/75	T10	7	4	2	3	1
6	F/67	L3	8	6	4	4	3
7	F/67	T11	9	6	2	3	2
8	F/63	L1	7	4	3	3	2
9*	F/69	T12	9	7	6	7	6
10	F/62	L2	8	6	3	3	3
11*	F/72	L1	7	5	6	6	5
12*	F/80	T12	9	7	6	6	5
13	F/58	L2	9	5	5	3	2
14	F/73	T12	8	6	3	2	2
15	F/70	L1	8	5	4	4	2
16	F/61	L4	8	5	3	3	2
17	F/58	L2	9	6	2	1	2
18	F/77	T10	8	6	3	2	3
19*	F/71	T9	7	5	6	6	4
20	F/68	T12	8	4	4	3	2
21	F/70	T11	9	6	4	7	6
22	F/62	T12	8	6	4	3	3
23	F/64	L1	8	5	4	3	2
24	F/66	L3	9	6	4	3	3
25	F/78	T12	9	6	4	4	3

* : unsuccessful case

We performed the radioifrequency neurotomy at involved compression fracture level including above and below the fracture site.

Evaluation of the pain was performed by applying the visual analogue scale(VAS). The VAS scores before treatment were compared to the scores obtained at 2 weeks, 6 weeks, 3 months after treatment. The result was regarded as the successful one if pain reduction exceeded 50% on the VAS at 6 weeks.

Results

Involved vertebrae were located from levels T9 to L4. The levels were T9(n=1), T10(n=2), T11(n=2), T12(n=8), L1(n=6), L2(n=3), L3(n=2) and L4(7=1).

The procedures were technically successful in all patients. A result was regarded as successful if pain reduction exceeded 50% on the VAS at 6 weeks. Six of the 25 patients did not respond favorably to RFN (pain reduction less than 50%), and 19 patients (Table 1). Pain was relieved within a week with a decrease in the VAS score from 5.48 to 2.96.

There were no neurologic complications such as sensory dysesthesia, neuritis and so on.

Discussion

Percutaneous vertebroplasty is currently indicated for palliative therapy for pain that is medically uncontrollable osteoporotic compression fracture[1,2,4]. However, for the cases of compression fractures, although vertebroplasty may result in improvement of symptoms, patients often experience remained pain along the rib margins Osteoporotic compression fracture results in low back pain in that the pain is not clearly related to the degree of tissue damage. Radiographs, magnetic resonance imaging(MRI) scans and bone density give no indication of the degree of pain[3]. So it is important to appreciate the complexity of pain mechanism. Pain is never a simple sensation, it is always a perception, but it is the end point of a complex process of cortical appraisal[6].

Pain in osteoporosis is unlikely to occur in the absence of

nociception, but troublesome pain does not imply high levels of nociception or worse tissue damage. Low levels of nociception can produce troublesome distress and disability in unfavorable circumstances.

Discussion of the pain processes in osteoporotic compression fracture must include various potential sources of pain within the spine and surrounding tissues. Pain arises only form innervated tissue. Various potential sources of pain of compression fracture should be identified for complete pain relief and better results.

Pain caused by nociceptors in bone itself

People definitely feel pain when bone is fractured. A fracture disrupts the periosteum, which is densely innervated and can be a source of nociception through either injury or mechanical deformation. A fracture that disrupts the periosteum provokes pain. Similarly, the endplate is well innervated and probably has some pressure transduction properties. Since alterations in loading across the endplate produces pain[5], disruption of the endplate by a fracture produces pain. However, it is uncertain whether this is always the case. Schmorl's nodes represent a herniation of a disc through the endplate, and these are generally thought to be asymptomatic. The acute inflammation and hemorrhage that accompany the injury increase pain by mechanisms described below. It is determined that the pain caused by such pain mechanism may be resolved by vertebroplasty. Amar et al[1] have reported that the mechanism of pain relief after vertebroplasty is that first, polymethylmethacrylate (PMMA) strenghthens the vertebral body mechnically preventing its compression, deformity and micromovement. Secondly, the polymerization of PMMA injected into the spine occurs and heat is generated at the same time causing heat damage in the peripheral nervous area that is sensitive to pain in the spine which results in pain. Thirdly, PMMA monomer that is not polymerized is toxic to nervous tissues damaging nociceptive nerve in the spine. Thus the pain is reduced by vertebroplasty procedure. In other words, through vertebroplasty, the pain caused by the nociceptors of bone itself could be resolved.

Facet joint pain and muscle pain

Both the facet and costovertebral joints are well innervated and are agreed to be a source of pain in many spinal conditions. Any significant abnormal angulation of the spine caused by collapse causes alteration to the neutral position and stresses the joint capsule and the articular cartilage[7]. This alters the local biomechanics causing pain. It is also likely to provoke spinal reflexes in the affected segments causing paraspinal muscle spasm. The pain caused by such mechanism is determined to be resolved by radiofrequency neurotomy. Particularly in some severe compressions, the overburden of the facet joint is increased, and thus it is thought that the pain originated from the facet joint is increased. In our study, similarly, by performimg RF neurotomy after vertebroplasty, a satisfactory result without major complications could be obtained.

Despite the fact that we could not confirm statistical significance using small number of patients and it is difficult to make a definite objective decision, RFN is considered to relieve remained symptoms after vertebroplasty safely due to the complexed pain mechanism mentioned above.

Namely, the authors propose that pain caused by nociceptors in bone itself is relieved by percutaneous vertebroplasty and the remmant pain originated from facet joint and muscle may be resolved by safely RFN after vertebroplasty .

Yet strict selection of target patients, long term follow ups and studies of control group may be necessary in the future.

Conclusion

The radiofrequency neurotomy may be both feasible and useful treatment for the remnant pain after vertebroplasty for severe osteoporotic compression fracture.

References

1. Amar AP, Larsen DW, Esnaashari N, Albuquerque FC, Lavine SD, Teitelbaum GP : Percutaneous transpedicular polymethylmethacrylate vertebroplasty for the treatment of spinal compression fractures. **Neurosurgery 49** : 1105-1114, 2001
2. Barr JD, Barr MS, Lemley TJ, McCann RM : Percutaneous vertebroplasty for pain relief and spinal stabilization. **Spine 25** : 923-928, 2000
3. Boos N, Rieder R, Schade V, Spratt KF, Semmer N, Aebi M : The diagnostic accuracy of magnetic resonance imaging, work perception, and psychosocial factors in identifying symptomatic disc herniations. **Spine 20** : 2613-2625, 1995
4. Cotten A, Boutry N, Cortet B, Asaker R, Dermondion X, Leblond D, et al : Percutaneous verterbroplasty : state of the art. **Radiographics 18** : 311-320, 1998
5. Mcnally DS, Shackleford IM, Goodship AE, Mulholland RC : In vivo stress measurement can predict pain on discography. **Spine 21** : 2580-2587, 1996
6. Noh CH, Yi JS, Lee HJ, Yang JH, Lee LW, Kim MC : Effect of percutaneous vertebroplasty with polymethylmethacrylate to osteoporotic spinal compression fractures and bursting fractures. **J Korean Neurosurg Soc 35** : 365-371, 2004
7. Price DD : Psychological and neural mechanisms of the affective dimension of pain. **Science 288** : 1769-1772, 2000

Commentary

Vertebroplasty already has become a popular minimally invasive procedure for fractures of the spine resulting from osteoporotic or tumorous lesions. I enjoyed this interesting article by SY Kim and SW Kim on the treatment of the remnant pain after vertebroplasty. This paper classified the pain of vertebral compression fracture into pain from vertebral body itself and facet joint associated with muscles. The authors rationalized their radiofrequency neurotomy procedure to treat

the pain from facet and surrounding muscles.

Though the author's concept is new, I suggest thinking about the other cause of pain originated from neural compression at the neural foramen. Bone cement can be leaked into neural foramen, which can result in radicular pain. The leakage of bone cement can be associated with the preexisting cortical destruction, rich posterior internal venous plexus, and inadequate needle puncture hole with inadvertent cortical perforation[2]. The heat and chemical irritation of bone cement can be another cause of pain[1]. Authors should have to study the status of neural foramen to check the compression of nerve root by bone cement, which should be sometimes managed by surgery[3]. In this study, 6 out of 19 patients did not satisfied with the neurotomy.

Nevertheless, this study showed very fresh concept of the remnant pain after vertebroplasty, which can be managed by radiofrequency neurotomy. As far as I am aware, there are no published studies on the effects of radiofrequency neurotomy on remnant pain after vertebroplasty. Especially, authors limited the patients with compression ratio more than 50%, which means more possibility of facet and muscular injury. I think this procedure can be one of options to treat the remnant pain after vertebroplasty in severely compressed osteoporotic spine.

Keun Su Kim, M.D.
Department of Neurosurgery, Yonsei University

References

1. Kelekis AD, Martin JB, Somon T, Wetzel SG, Dietrich PY, Ruefenacht DA : Radicular pain after vertebroplasty : compression or irritation of the nerve root? Initial experience with the "cooling system". **Spine 28** : E265-269, 2003
2. Laredo JD, Hamze B : Complications of percutaneous vertebroplasty and their prevention. **Skeletal Radiol 33** : 493-505, 2004
3. Ratliff J, Nguyen T, Heiss J : Root and spinal cord compression from methylmethacrylate vertebroplasty. **Spine 26** : E300-302, 2001