Gray Ramus Communicans Nerve Block: A Useful Therapeutic Adjuvant for Painful Osteoporotic Vertebral Compression Fracture

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Objective: There are limited treatment options for patients with painful osteoporotic vertebral compression fracture (OVCF) in whom surgery is not strongly indicated or when pain persists even after vertebroplasty. Conservative treatments generally do not provide adequate or prolonged pain relief since the pain in these patients is thought to originate from within and surrounding vertebra. The purpose of this study is to verify the usefulness of percutaneous nerve block on gray ramus communicans in these patients.

Methods: We retrospectively analyzed 36 patients in whom nerve blocks on gray ramus communicans were performed for painful OVCF after failure of conservative therapy and/or after percutaneous vertebroplasty. Bilateral nerve blocks were done on the gray ramus tracts of the somatic nerve roots corresponding with OVCF under C-arm fluoroscopic guidance. Patient-reported pain scores and amount of analgesic medication were measured.

Results: All patients tolerated procedures well. Significant initial pain relief was noted in 34 (94.4%) patients and the pain relief was durable in 30 (88.2%) of these 34 patients at last visit (at least 4 months after procedure). None of these patients required surgeries during the follow-up period. Decreased analgesic requirement was documented in 30 (83.3%) of patients. There was no procedure related complication.

Conclusion: Prompt and relatively prolonged improvement of pain without complication after this procedure in majority of patients with persistently painful OVCF supports its effectiveness and safety. Thus, it may be considered a useful adjuvant therapeutic option in these clinical settings.

KEY WORDS: Osteoporosis, Compression fracture, Gray ramus communicans, Nerve block.

Introduction

Rapidly increasing elderly population and concurrent increase in incidence of osteoporosis and painful osteoporotic compression fractures are being witnessed in recent years. However, there have been only limited number of effective treatment options for these patients. In the past, they were generally managed in bedridden state with conservative treatment that may cause further bone resorption and increase risk for secondary fracture. Recently, vertebroplasty or kyphoplasty have shown to provide rapid pain relief, stability and functional restoration. However, judicious use is recommended due to potential risks and side effects. Therefore, factors such as benefit-risk and cost-effectiveness must be carefully considered, especially in whom surgery is not strongly indicated or pain persists even after these percutaneous procedures, when choosing a therapeutic option for these painful and disabled patients.

The object of this study is to verify the usefulness of nerve block on gray ramus communicans (GRC) in patients with persistent pain after osteoporotic vertebral compression fracture (OVCF) in whom the surgery is not indicated or when pain persists even after vertebroplasty.

Materials and Methods

Thirty-six patients with 48 vertebrae (32 lumbar, 16 thoracic) were treated during a recent 10-month period in our institution. The patients included were 10 males and 26 females (male to female ratio 1:2.6 and age range of 57-83 years with mean 67 years). Among these, 29 were not surgically indicated but severe pain persisted despite various conservative treatments and 7 were still painful after percutaneous vertebroplasty (PVP). In all patients, at least 4 weeks of physiotherapy and rehabilitation therapeutic program had failed to provide subs-
tantal pain relief. We retrospectively analyzed these cases in whom the gray ramus communicans nerve blocks (GRCNB) were provided for painful condition from osteoporotic compression fracture.

Patients were placed in prone position with a pillow under abdomen and arms hanging over the table. Under C-arm fluoroscopic control, the 23-gauge spinal needle was inserted laterally about 3.5~5.0 cm from the midline of vertebral body just inferior to the transverse process, usually 1.5~2.0 cm lateral to inferior endplate in case of thoracic region. Then, the needle was advanced through just inferior to the pedicle and advanced into slightly anterosuperior aspect of the foramen. The needle tip was positioned about 5~10 mm anterior to foramen and just above the roof of the foramen where the most proximal portion of gray ramus communicans is known to be located. Correct position was then confirmed radiographically with injection of 0.5 cc of contrast dye (Telebrix®). When optimal needle position was confirmed, a 3 cc mixture (combination of 1 cc of 2% lidocaine, 5 mg of dexamethasone and 40 mg of methylprednisolone acetate) was injected on each side of the gray ramus tract of the somatic nerve root corresponding with radiographically documented fractured vertebra (Fig. 1).

To obtain only the blockade effect from gray ramus communicans, these blocks were performed on only level(s) that corresponded to the pathologic vertebra(e).

Patient’s vital signs and any side effects were carefully monitored during entire procedure. After the procedure, the patient was sent to recovery room and was observed for 2 hours to detect any signs of complications or delayed side effects. For the evaluation of therapeutic effects, the patient-reported pain scores and amount of analgesic medication were measured. The follow-up period ranged from 4 to 12.5 months with a mean of 9.3 months.

Results

Pre- and postoperative pain was assessed using a 10-point scale (visual analog pain score, VAS). In the 36 patients treated for OVCF, initial pain relief was recorded within the first 24 hours. Average preoperative pain scale reported by patients was 9.2. The degrees of compression of the vertebrae ranged from approximately 20 to 40%. The bone mineral density (BMD) determined in femur neck ranged from -3.0 standard deviation (SD) to -1.0 SD with a mean -2.11 SD.

Marked pain relief, defined as a postoperative pain level of 0 to 3, was achieved in 29 (80.5%) patients. Moderate pain relief, corresponding to a postoperative pain level of 4 to 6, was repo-
in 5 (13.9%) patients. Two patients had no significant pain relief, but no patient reported worsening of pain (Fig. 2). GRCNB provided significant initial pain relief in 34 (94.4%) of 36 patients with OVF.

There was no statistical difference with regard to the degrees of pain relief between those who were treated conservatively and those who were still painful even after vertebroplasty. Pain relief was durable in 30 (88.2%) of these 34 patients at a mean follow-up period of 9.3 months (Fig. 3). Average postoperative pain score was decreased from 9.2 to 2.8 (mean reduction 6.4). Six patients had recurrent painful episodes during this time. Two patients were treated again for new fractures that occurred at 49th and 76th day after initial therapy. Their pain reliefs were achieved again to the level of the initial postoperative state. Only 4 patients (11.8%) experienced delayed recurrent pain corresponding to the levels treated. PVP was performed in one of these patients, in whom progressed vertebral compression was documented radiologically. Remaining three patients were treated with radiofrequency (RF) thermoablation on GRC only because vertebral heights of these were not changed and there was no noticeable spinal instability or canal impingement. Overall analgesic medication was decreased in 30 (83.3%) of 36 patients treated with initial GRCNB. These patients have reported that they were able to tolerate without regular pain medications and only 2 or 3 OCT (over-the-counter) pain killers per week were necessary.

With respect to complications, there was no complication, such as pneumothorax, hemothorax, abscess, vasovagal reaction, and adrenal crisis, related to GRCNB. However, 3 patients complained of transient facial flushing, 2 patients of headaches, 2 patients of radicular pain along the chest wall, and 1 patient of transient lower extremity weakness. All of these reactions were temporary and there was no permanent complication.

**Discussion**

Osteoporosis, the most common metabolic bone disease, is a major public health challenge. Although it is a generalized disorder of the skeleton, the major morbidities result from fractures of the vertebrae and hips. Although hip fractures usually occur with a fall, vertebral compression fractures may occur after sudden bending, lifting, or jumping movements that may have seemed trivial. Women over age 65 lose on average 1% of BMD per year. A decrease in BMD by only 1 SD increases the risk of a spinal fracture by 1.9-fold and the risk of hip fracture by 2.4-fold. The loss of BMD in the spine significantly reduces the failure load of the vertebral body which increases the risk of fracture. Kado et al revealed that 20% of women had one or more vertebral fractures in their study of 9,575 women older than age 65.

Recently, percutaneous vertebroplasty with acrylic cement has been increasingly used to treat OVF for the relief of the pain and strengthening of the vertebrae. This procedure is fairly simple and cost-effective to provide a prompt and effective pain relief and functional restoration. Despite having thermogenic reaction, it is usually well tolerated. However, serious complications have been reported. Leakage of cement outside the vertebra is relatively common during vertebroplasty, even it is clinically silent in the majority of cases. A number of pulmonary embolisms caused by cement particles also have been reported in the literature. A very small number of serious neurological complications (paraplegia due to leakage of cement into the spinal canal) were recorded. Therefore, the careful evaluations and investigations are mandatory to prevent these complications.

Kypheoplasty, in which the cement can be injected at a lower pressure than vertebroplasty, thus minimizing the risk of cement leakage, must be performed very early, within the first few days after the fracture to correct the vertebral deformity. Despite its advantages, the consideration on economic burden upon patients must be taken since it is very expensive.

Most vertebral fractures heal within a few weeks or months. A minority of patients continue to have pain that does not respond to conservative therapy or even after these percutaneous procedures. However, conventional treatment and various nerve blocks generally do not provide adequate or prolonged pain relief since the pain in these patients is thought to originate from within the vertebra.

In patients in whom the conventional management of pain that results from OVF has failed, our study indicates that GRC blocks seem to offer highly successful minimally invasive procedures for pain reduction. Patient-reported pain scores may not be objective. However, when considered along with degrees of reduction of previous medication, these scales could be justified with regard to objectivity. This type of nerve block was initiated from the basis of the observation of the course of gray ramus, containing unmyelinated postganglionic fibers which rejoin dorsal and ventral rami, distributing around vertebral body wall and coursing into anterior disc and thus possibly providing major sensory input for vertebral compression fracture. It is known that gray ramus communicans nerve provides the greatest source of disc innervation and vertebral column. Although anecdotal our preliminary experimental GRC blocks have provided excellent immediate pain relief in 16 patients. Result from these patients has served the basis and initiated this pilot study. Compression fracture on vertebral...
body may also have impact on surrounding structures such as facet joints and some portion of pain may be attributed to these structures. But, the pain originating from facet joints and surrounding soft tissue would respond well to the conventional nerve blocks (i.e., facet blocks or nerve blocks on medial branch of posterior primary ramus). Our patients were all refractory to these types of blocks.

Although GRC block provides significant initial pain relief of patients with OVCF, it does not restore the strength of the fractured vertebra. One patient, in our study, showed progression of compression and her BMD score was -2.9 SD. This patient underwent vertebroplasty. When severe osteoporosis is noted, such as this case, vertebroplasty or kyphoplasty may be optimal.

In case with recurrent episodes of severe pain after successful initial treatment, as in 3 of our cases (8.3%), a more definitive management for pain relief is recommended. If painful episodes are repeated without progression of compression, a RF lesioning can be tried. Although its effect has not been reported for this type of clinical setting, it would be indicated when initial nerve block provided more than 50% of pain relief. It seems that RF treatment provides similar degrees of pain relief with more extended period of the duration of pain relief. Therefore, it may be indicated when recurrent severe pain occurs and prolonged pain relief can be expected.

With respect to complications, Chandler et al. reported potential risks, including infection, bowel puncture, intravascular injection, somatic nerve root trauma, intrathecal or epidural injection, kidney puncture with a far lateral approach and pneumothorax in thoracic approach. However, there was no such a serious complication in this study although a few patients complained of mild, temporary complications or side effects (3 patients with transient facial flushing, 2 with headaches, 2 with radicular pain along the chest wall, and 1 with transient lower extremity weakness). In this regard, GRC block seems to be feasible and safe when performed in selected patients, with basic anatomic knowledge and safety measures.

Lastly, we emphasize that GRC block should be regarded only as a adjuvant therapeutic modality mostly focused on pain relief and functional restoration from spinal dysfunction due to painful condition. Therefore, once successful pain relief is obtained, therapeutic exercise along with a diet that is adequate in calories, protein, calcium, and vitamin D and antosteoporotic drugs, such as calcitonin and bisphosphonates are necessary to avoid further bone mineral loss and subsequent new fractures should be instructed with or without additional surgical correction of compressed vertebral bodies.

**Conclusion**

Prompt and relatively prolonged improvement of pain, without significant complications, after nerve block on gray ramus communicans in majority of patients with persistently painful OVCF supports its usefulness, cost-effectiveness, and safety as an adjuvant therapeutic modality.

Thus, it is considered as a safe and useful option in selected patients with painful OVCF in whom surgery is not absolutely indicated or when pain persists even after vertebroplasty. Prospective and controlled studies with larger population are needed for more clear validation of its usefulness in long term period.

**References**