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Radiofrequency Facet Joint Denervation in the Treatment of Low Back Pain: Relationship with the Diagnostic Block

Jae Chol Shim, M.D., and **Ik Sang Seung**, M.D.

Department of Anesthesiology, College of Medicine, Hanyang University, Seoul, Korea

= **Abstract** =

Background: Response to diagnostic blocks does not consistently predict the outcome of interventional facet denervation. We investigated the relationship between pain relief by the percutaneous radiofrequency denervation of the lumbar zygapophysial joints with the result of facet joint diagnostic local anesthetic injection in patients with back pain originating from the lumbar zygapophysial joint.

Methods: There were 35 patients enrolled, with ranging in age from 25 to 76 years (52.6 ± 12.7 years, mean ± SD). We studied 7 men (20%) and 28 women (80%). All patients underwent double diagnostic block of $L_{3/4}$, $L_{4/5}$ and L_5-S_1 facet joint with 0.5% bupivacaine. The 35 patients fell into the following group. (1) Group A (n = 16): those who felt clear relief (pain free with Likert scale) from the double diagnostic block (2) Group B (n = 19): 11 patients who were always equivocal in their response to the double diagnostic block and 8 patients who were either pain free or equivocal in their response to the double diagnostic block. All 11 patients were done the facet joint denervation. The effect on the pain was evaluated with 4 point Likert scale 1, 6 and 12 weeks after the procedure. We evaluated the relationship between the pain response to diagnostic block and the pain relief with facet joint denervation.

Results: Significant correlation was observed between the response to diagnostic block and pain relief with facet denervation ($P < 0.05$). We found no correlation between the categories of spinal operation and pain response to facet denervation (P value > 0.05).

Conclusions: A satisfactory result of lumbar facet joint denervation can be obtained in many patients, especillay in patients whose pain were relieved by the diagnostic double facet joint block. It may be said that facet joint denervation for mechanical low back pain using radiofrequency thermocoagulation is a safe, easy, and repeatable technique.

Key Words: Diagnostic block, Facet denervation, Low back pain, Zygapophysial joint pain

INTRODUCTION

Percutaneous radiofrequency (RF) facet neurotomy is a useful and minimally invasive procedure in which selected nerves are thermally lesioned with electrodes to destroy their ability to conduct pain. It has been used for more than two decades and has a number of advantages over more invasive procedures when performed by experienced physicians on carefully selected patients. RF neurotomy can consistently achieve positive results in a substantial subset of patients, most of whom have failed conservative therapy or are not candidates for other invasive treatments.[1-4]

It has generally been impossible to identify objective

Corresponding to : Jae Chol Shim, Department of Anesthesiology, Hanyang University Hospital, #17 Haengdang-dong, Seongdong-gu, Seoul 133-792, Korea
Tel: 02-2290-9228, Fax: 02-2299-0742
E-mail: jcshim@hanyang.ac.kr

criteria that can reliably predict which patients will respond to treatment for painful facet joints. If pain fails to resolve with conservative care, diagnostic blocks, in which the facet joint or its nerve supply is injected with local anesthetics to test the hypothesis that the facet joint is the source of pain, may be useful. The blocks remain controversial, and physicians continue to debate whether they are necessary or reliable and how they should be performed. Controlled diagnostic block is an imperfect predictor of facet denervation treatment, but they are widely accepted as the best diagnostic test now available for facet joint pain. They can be highly accurate; in one carefully done study, the positive predictive value was over 95%.[5] The International Spinal Injection Society (ISIS) standards support the use of controlled blocks and note that "true-positive responses are secured by performing controlled blocks".[6] But if not the controlled block using two different agents with different durations of action, the ability of blocks to predict reliably the success of facet procedures has been debated for years.

We wondered if the response to diagnostic double block using single agent can reflect the therapeutic effectiveness of facet joint denervation. Moreover this has led us to some doubt as to the role of these diagnostic block in the consistency of predicting the outcome of interventional treatment. To investigate the ability of diagnostic block using single agent in predicting the outcome of facet joint denervation, we evaluated the relationship between the pain response to diagnostic blocks and the pain relief with facet joint denervation.

METHODS

Forty six patients who fulfilled the following criteria for facet joint pain were studied: 1) The duration of pain was at least one year. 2) Pain was confined to low back and hip (did not spread out to the legs). 3) Pain had a blunt character, not sharp, and was not easily localized (dermatomal radiation strongly suggests radiculopathy). 4) Neurological deficit could not be detected in the distribution of the sciatic nerve. 5) Radiological evidence of discogenic or stenotic compression upon the spinal cord or roots could not be found. Forty six patients were given an initial injection of local anesthetics (0.5 ml of 0.5% bupivacaine) into the appropriate painful joints as assessed by examination under the image intensifier. They were then asked to assess their pain relief over the following 12 hours. The pain relief was evaluated with 4 point Likert scale (none, moderate relief: $< 30\%$, good: $30\% <$ pain $< 50\%$, pain free: $> 50\%$). We considered the diagnostic block to have been equivocal if the patient's response was moderate or good, and pain free if the patients reported more than 50% reduction of pain.

After 1 week we evaluated the pain relief and the patients who reported more than 30% reduction of pain were given the second injection of local anesthetics (0.5 ml of 0.5% bupivacaine) into the appropriate facet joint again. 11 patients who gained no relief from the injections took no further part in the study. 35 patients (male : female = 7 : 28) who were pain free or equivocal in their response were enrolled. The 35 patients fell into the following group. (1) Group A (n = 16): those who felt clear relief (pain free with Likert scale) from the double diagnostic block (2) Group B (n = 19): eleven patients who were always equivocal in their response to the double diagnostic block and eight patients who were either pain free or equivocal in their response to the double diagnostic block. Two categories were used for patients in this study, as follows: Category 1: there were 27 cases (77%) who had no operations. Category 2 : 8 cases (23%) had undergone posterior fusion operation or some kind of spinal operation other than fusion.

Patients with either a pain free, good or equivocal response to injection were done the facet joint denervation using a radiofrequency lesion generator (Radionics RFG-3B, Radionics Inc. Burlington Mass., USA). The facet denervation was carried out with the patient lying prone on an table and able to describe pain sensations during the procedure. Under fluoroscopic guidance 21 gauge curved blunt tip radiofrequency needles with an active tip of 10mm were placed. The specific target points for the L3-L4 were the posterior surface of the most medial end of the transverse process just below its superior border at each level. For the L5 dorsal ramus the target point was

Table 1. Correlation between Response to Diagnostic Block and Pain Relief after Facet Denervation

Response to diagnostic block	4 point Likert scale (n)											
	1 Week*				6 weeks*				12 weeks*			
	1	2	3	4	1	2	3	4	1	2	3	4
Group A (n = 16)			1	15			3	11			1	12
Group B (n = 19)	2	2	8	7	2	5	8	2	2	2	4	4
Total (n)	35				31				25			

*All for 1, 6, 12 weeks after the facet denervation: $P < 0.05$.
4 point Likert scale: 1 = none, 2 = moderate relief; < 30%, 3 = good; 30% < pain < 50%, 4 = pain free; > 50%, Group A: those who were pain free in their response to double diagnostic block, Group B: those who were equivocal or pain free/equivocal in their response to double diagnostic block.

the medial end of the ala of the sacrum. A lateral views further confirms the correct placement of the cannulae at L_5, L_4, and L_3 with the tips well posterior to the respective foramina. Stimulation was then carried out at 50 Hz. Paresthesias in the paravertebral and hip area should be noted when the medial branches of the appropriate facet joint are stimulated Iat this frequench. Attempts were made to cause paresthesia with less than 0.5 mV, otherwise the needle was repositioned. Afterwards stimulation with 2 Hz was done to see if no motor response was evoked. The medial branch was then anesthetized with 2% mepivacaine 0.5 ml, followed by a radiofrequency lesion of 80°C for 60 seconds. Patients were discharged the next day. Patients visited our pain clinic again 1, 6 and 12 weeks after the procedure and the effect on the pain was ealuated with 4 point Likert scale. We considered the facet denervation to have been successful if the patients reported more than 50 percent reduction of pain.

Statistical analyses of the relationship between the pain response to diagnostic block and the response to facet joint denervation was done with the Statview (Abacus Concept. USA) using the chi square test. P value < 0.05 was considered statistically significant.

RESULTS

There were 35 patients enrolled, with age ranging from 25 to 76 years (52.6 ± 12.7 years, mean ± SD). We studied 7 men (20%) and 28 women (80%). We lost four patients at 6 weeks follow up and more six patients at 12 weeks follow up. The laterality for facet injection and denervation is right side in twenty patients, left side in eleven patients and both side in four patients.

Using chi square analysis, we observed a significant correlation ($P < 0.05$) between the response to diagnostic block and the pain response to facet denervation after 1, 6 and 12 weeks after the facet denervation. Six weeks after the facet denervaton, 37% of the patients had experienced more than 50% reduction of pain. A successful facet denervation of more than 50% reduction of pain was achieved in 46% of the patients at twelve weeks postoperatively (Table 1). We found no correlation between the categories of spinal operation and pain response to facet denervation ($P > 0.05$). There were no adverse effects reported by the patients and no evidence of a nerve root anesthesia or damage.

DISCUSSION

The significance of the facet joint as a cause of low back pain and its treatment by facet injection remain confusing. The clinical facet syndrome is poorly defined and there is frequently absence of morphological abnormalities. However, it seems reasonable to assume that facet

joints might be the source of low back pain for some patients[7] and for these patients a facet denervation would then be warranted. The facet syndrome is a poorly defined entity in which pain is thought to originate from the facet joints.[8] There is no reliable specific test to diagnose facet syndrome and the diagnosis is often arrived at by exclusion. Lippitt[9] described the symptoms of a classic facet syndrome. The definition of facet joint syndrome by this complex of symptoms and signs is not specific enough to be of diagnostic value. Therefore, facet syndrome is not a reliable clinical diagnosis.[10]

Facet joint pain can be difficult to distinguish from other types of back pain. If degenerative changes occur in more than one spinal structure,[11] it is difficult to separate multiple elements that cause back pain, and most physical examination techniques stress several structures at the same time, particularly the discs, facet joints and paraspinous muscles.[12] Some studies have identified clinical characteristics more often before associated with a positive response to facet joint injection, but investigators generally have not been able to identify objective criteria that can reliably predict which patients will respond to treatment for painful facet joints.[1,12,13] Not all patients who present with chronic back pain, with or without leg pain, are candidates for facet denervation. While facet joint denervation has a part to play in the treatment of back pain, in order to achieve success initial rigorous selection is required. Selection of the patients who benefit from this procedure is difficult because differentiation between facet syndrome and other causes of low back pain is also difficult. Patient selection for these procedures has been primarily determined clinically and by facet joint blocks. Patients should also show convincing improvement following diagnostic injection with local anesthetic before denervation is carried out. Facet injection criteria have been suggested to be exclusive of previous back operation. A possible explanation is though to lie in the multiple pathology of pain. In contrast to this contention the success rate was 20−40% in category 2 patients.[14,15] Goecer et al[16] reported pain relief in 41.7% of patients with previous back operation. In our study eight patients of category 2 had undergone posterior fusion operation or some kind of spinal operation other than fusion. We found no correlation between the categories of spinal operation and pain response to facet denervation ($P > 0.05$). We found four cases (50%) in category 2 had satisfactory results after 12 weeks of facet denervation. Three cases of spinal fusion were included in category 2. Five cases had had only one spinal operation, which was limited only to laminectomy; improved outcome which is in accordance with that of Gocer et al [16] was suggested in our category 2 patients, if 3 cases of spinal fusion were excluded. It is suggested that facet denervation would be beneficial for the patients with previous back operation, although the success rate is lower than patients without back operation.

Conservative care may be prescribed on the basis of physical examination, patient-reported patterns of pain, and imaging results, but if the pain fails to resolve, diagnostic blocks may be required. These blocks, in which the facet joint or its nerve supply is injected with local anesthetics to test the hypothesis that the facet joint is the source of pain, remain controversial. A number of issues surrounding diagnostic blocks have been debated for years:

First, the need to use diagnostic blocks at all. Studies continue to be published in which clinical or radiographic features alone are used to select patients for procedures that attempt to relieve zygapophyseal joint pain.[3,17] Some experienced practitioners believe that a sufficiently presumptive diagnosis can often be made by history and physical examination alone. Many others believe that diagnosis must include diagnostic blockade because clinical symptoms are not specific enough to be definitive.[18]

Second, the ability of blocks to predict reliably the success of facet joint procedures. False negative or false positive responses to these blocks can have several specific causes: the needle used to inject the local anesthetic may be placed incorrectly, the anesthetic may not adequately infiltrate the target nerve, venous uptake may occur, or the anesthetic may inadvertently spread to surrounding muscle, the spinal nerve, or other structures.[18] These problems are believed to be rare; nonetheless, response to diagnostic blocks does not consistently predict the outcome of interventional treatment, even when

controlled blocks are used.[1,20] A number of reasons have been proposed for this, including technical failure of therapeutic procedures or a variable and unpredictable placebo response.[1,21]

Third, the utility of single versus controlled blocks. Single diagnostic blocks have been shown to gave a high false positive rate as high as 27% (95% CI 15%, 38%).[2,22] Double blocks using two different agents with different durations of action have been demonstrated to be diagnostically more valid and much less prone to false positive responses because the patient is required to identify correctly the duration of relief obtained with each block.[2,22] Nevertheless, single blocks continue to be used.[4]

Fourth, the use of saline injections as a placebo control along with a local anesthetics. Ethical objections have been raised to the use of an inert substance, and the use of two different anesthetics is more common.[6] ISIS standards for the performance of spinal injection procedures note that ideally controlled blocks would involve the use of saline as a placebo but that "logical and ethical considerations mitigate against its use in conventional practice".[6] ISIS supports the use of saline only in concert with two local anesthetics (which requires three blocks of the same joint for each patient) and requires informed consent to a sham procedure.[25]

In summary, controlled diagnostic blocks are an imperfect predictor of treatment success, but they are widely accepted as the best diagnostic test now available for facet joint pain. They can be highly accurate; In one carefully done study, the positive predictive value was over 95%.[5]

The ISIS standards support the use of blocks and note that "true-positive responses are secured by performing controlled blocks".[6]

These studies[1-4] cover lumbar facet neurotomies. As with most non-drug trials, most of these are small and look at short-term outcomes. Inclusionary and exclusionary criteria differ greatly. Some investigators used controlled blocks, some used a single block, and some used none. As noted elsewhere[1] the variations in patient selection, technique, and outcome assessment make comparison of results or meta-analysis impossible. However, three important conclusions can be drawn. First, quality studies are being performed, with positive results. A recent paper describing long term follow-up of an earlier study noted that RF neurotomy "is the only treatment for neck pain that has survived a randomized, double blind, controlled trial and which achieves complete relief of pain".[25] Second, percutaneous facet neurotomy can be effective in relieving chronic, disabling pain. In every study, significant pain relief was obtained in many patients. The best results were in the largest study, with relatively long follow-up (324 patients followed for an average of 22.5 months after lumbar neurotomy); 96% of patients reported no back pain and normal activities or intermittent pain only without significant interference with activity.[3] In the study with the lowest percentage of patients reporting satisfactory results, 45% had reduced pain six weeks postoperatively. Third, the procedure is extremely safe. No study reported serious or long-lasting adverse effects. No patient reported a worsening of preoperative pain. The safety of the technique and the ability to perform it on out-patients are obvious advantages.

We have demonstrated a reduction in pain scores following facet joint denervation of approximately 37% at 1 month and the reduction is sustained at least for 3 months (Table 1). Facet joint denervation is therefore beneficial in patients presenting with low back pain and the characteristic set of symptoms outlined in our method. Our study also suggests that diagnostic facet joint injection with local anesthetic is worthwhile as a screening procedure to predict a positive outcome in facet joint denervation. This confirms uncontrolled studies[3,4,17] which have also shown that a good response to local anesthetic is an important predictive indicator. Although our patient selection was rigorous, eleven patients were not helped by facet joint injection. Fourteen of the nineteen patients in group B did not improve with facet joint denervation 1 week postoperatively (Table 1). This suggests that the procedure of facet joint denervation should be reserved for those reporting a clear temporary improvement from local anesthetic.

However, our investigation was compromised by certain methodological flaws: the diagnosis of zygapophysial joint pain was made using double block using single agent, re-

sponse to radiofrequency facet joint denervation was considered as criterion standard, and independent observers were not used in order to eliminate observer bias. Review of diagnostic double block using single agent compared with that using different agents is beyond the scope of this paper. We expect the definitive studies demonstrating the value of diagnostic double blocks using single agent by comparing their diagnostic value with placebo or other agents.

We have found that both facet joint injections and denervation are safe procedures. There were no adverse effects reported by the patients and no evidence of a nerve root anesthesia or damage. The safety of radiofrequency lesions is borne out in animal studies that show that 80°C lesions result in reversible damage to neurons of similar diameter.

In conclusion, a satisfactory result can be obtained in many patients, if patients whose pain were relieved by the diagnostic double block using single agent are carefully selected. This study has demonstrated improvement in pain scores following facet joint denervation when the patient is rigorously selected and confirms its place as a useful tool in the management of mechanical low back pain. It may be said that facet joint denervation for mechanical low back pain using radiofrequency thermocoagulation is a safe, easy, and repeatable technique.

REFERENCES

1. North RB, Han M, Zahurak M, Kidd DH: Radiofrequency lumbar facet denervation: analysis of prognostic factors. Pain 1994; 57: 77-83.
2. Dreyfuss P, Halbrook B, Pauza K, Joshi A, McLarty J, Bogduk N: Efficacy and validity of radiofrequency neurotomy for chronic lumbar zygapophysial joint pain. Spine 2000; 25: 1270-7.
3. Cho J, Park YG, Chung SS: Percutaneous radiofrequency lumbar facet rhizotomy in mechanical low back pain syndrome. Stereotact Funct Neurosurg 1997; 68: 212-7.
4. van Kleef M, Barendse GA, Kessels A, Voets HM, Weber WE, de Lange S: Randomized trial of radiofrequency lumbar facet denervation for chronic low back pain. Spine 1999; 24: 1937-42.
5. Lord SM, Barnsley L, Bogduk N: The utility of comparative local anesthetic blocks versus placebo-controlled blocks for the diagnosis of cervical zygapophysial joint pain. Clin J Pain 1995; 11: 208-13.
6. Bogduk N: International Spinal Injection Society guidelines for the performance of spinal injection procedures. Part 1: Zygapophysial joint blocks. Clin J Pain 1997; 13: 285-302.
7. Mooney V, Robertson J: The facet syndrome. Clin Orthop 1976; 115: 149-56.
8. Murphy WA: The facet syndrome. Radiology 1984; 151: 533.
9. Lippitt AB: The facet joint and its role in spine pain. Management with facet joint injections. Spine 1984; 9: 746-50.
10. Jackson RP: The facet syndrome. Myth or reality? Clin Orthop 1992; 279: 110-21.
11. Mehta M, Parry CB: Mechanical back pain and the facet joint syndrome. Disabil Rehabil 1994; 16: 2-12.
12. Revel M, Poiraudeau S, Auleley GR, Payan C, Denke A, Nguyen M, et al: Capacity of the clinical picture to characterize low back pain relieved by facet joint anesthesia. Proposed criteria to identify patients with painful facet joints. Spine 1998; 23: 1972-6.
13. Revel ME, Listrat VM, Chevalier XJ, Dougados M, N'Guyen MP, Vallee C, et al: Facet joint block for low back pain: identifying predictors of a good response. Arch Phys Med Rehabil 1992; 73: 824-8.
14. Shealy CN: Percutaneous radiofrequency denervation of spinal facets. Treatment for chronic back pain and sciatica. J Neurosurg 1975; 43: 448-51.
15. McCulloch JA, Organ LW: Percutaneous radiofrequency lumbar rhizolysis (rhizotomy). Can Med Assoc J 1977; 116: 28-30.
16. Gocer AI, Cetinalp E, Tuna M, Ildan F, Bagdatoglu H, Haciyakupoglu S: Percutaneous radiofrequency rhizotomy of lumbar spinal facets: the results of 46 cases. Neurosurg Rev 1997; 20: 114-6.
17. van Suijlekom HA, van Kleef M, Barendse GA, Sluijter ME, Sjaastad O, Weber WE: Radiofrequency cervical zygapophyseal joint neurotomy for cervicogenic headache: a prospective study of 15 patients. Funct Neurol 1998; 13: 297-303.
18. Stolker RJ, Vervest AC, Groen GJ: The management of chronic spinal pain by blockades: a review. Pain 1994; 58: 1-20.
19. Dreyfuss P, Schwarzer AC, Lau P, Bogduk N: Specificity of lumbar medial branch and L5 dorsal ramus blocks. A computed tomography study. Spine 1997;

22: 895-902.

20. North RB, Kidd DH, Zahurak M, Piantadosi S: Specificity of diagnostic nerve blocks: a prospective, randomized study of sciatica due to lumbosacral spine disease. Pain 1996; 65: 77-85.
21. Lord SM, Barnsley L, Wallis BJ, McDonald GJ, Bogduk N: Percutaneous radio-frequency neurotomy for chronic cervical zygapophyseal-joint pain. N Engl J Med 1996; 335: 1721-6.
22. Barnsley L, Lord S, Wallis B, Bogduk N: False-positive rates of cervical zygapophysial joint blocks. Clin J Pain 1993; 9: 124-30.
23. Schwarzer AC, Aprill CN, Derby R, Fortin J, Kine G, Bogduk N: The false-positive rate of uncontrolled diagnostic blocks of the lumbar zygapophysial joints. Pain 1994; 58: 195-200.
24. Lord SM, Barnsley L, Wallis BJ, Bogduk N: Chronic cervical zygapophysial joint pain after whiplash. A placebo-controlled prevalence study. Spine 1996; 21: 1737-44.
25. McDonald GJ, Lord SM, Bogduk N: Long-term follow-up of patients treated with cervical radiofrequency neurotomy for chronic neck pain. Neurosurgery 1999; 45: 61-7.