ORIGINAL PAPER

Nagoya J. Med. Sci. **77**. 213 ~ 219, 2015

TREATMENT OUTCOMES OF INTRADISCAL STEROID INJECTION/SELECTIVE NERVE ROOT BLOCK FOR 161 PATIENTS WITH CERVICAL RADICULOPATHY

KEIGO ITO, MD, PhD; YASUTSUGU YUKAWA, MD, PhD; MASAAKI MACHINO, MD; TARO INOUE, MD; JUN OUCHIDA, MD; KEISUKE TOMITA, MD; and FUMIHIKO KATO, MD, PhD

Department of Orthopedic Surgery, Chubu Rosai Hospital, Nagoya, Japan

ABSTRACT

Patients with cervical radiculopathy (CR) were treated with intradiscal injection of steroids (IDIS) and/or selective nerve root block (SNRB) at our hospital. We retrospectively report the outcomes of these nonsurgical treatments for CR. 161 patients who were followed up for >2months were enrolled in this study. Patients' clinical manifestations were classified as arm pain, arm numbness, neck and/or scapular pain, and arm paralysis. Improvement in each manifestation was classified as "disappeared," "improved," "poor," or "worsened." Responses of "disappeared" or "improved" manifestations suggested treatment effectiveness. Final clinical outcomes were evaluated using the Odom criteria. Changes in herniated disc size were evaluated by comparing the initial and final MRI scans. On the basis of these changes, the patients were divided into regression, no-change, or progression groups. We investigated the relationship between the Odom criteria and changes observed on MRI. Effectiveness rates were 89% for arm pain, 77% for arm numbness, 82% for neck and/or scapular pain, and 76% for arm paralysis. In total, 91 patients underwent repeated MRI. In 56 patients (62%), the size of the herniated disc decreased, but 31 patients (34%) exhibited no change in disc size. The regression group showed significantly better Odom criteria results than the no-change group. In conclusion, IDIS and SNRB for CR are not widely performed. However, other extremely effective therapies that can rapidly improve neuralgia should be considered before surgery.

Key Words: Intradiscal Steroid Injection, Selective Nerve Root Block, Cervical Radiculopathy

INTRODUCTION

Cervical spondylotic or discogenic radiculopathy is common, and nonsurgical medical treatment is widely employed. Cervical radiculopathies are caused by root compressions and inflammations.[1)] Root compressions are caused by protruding discs, osteophytes, superior articular processes, ligamentum flava, and periradicular fibrous tissue.[2)] Most patients with acute radiculopathy due to soft disc herniation experience some remission of their symptoms.[3)] Therefore, conservative treatment is successful without surgery. However, conservative treatment is usually time-consuming and patients with severe pain strongly hope for rapid improvement. For patients with cervical radiculopathies, block therapies with anti-inflammatory action might be regarded as the first

Received: September 30, 2014; accepted: December 15, 2014

Corresponding author: Keigo Ito, MD, PhD

Department of Orthopedic Surgery, Chubu Rosai Hospital,1-10-6 Koumei, Minato-ku, Nagoya, Aichi, Japan

TEL:81-52-652-5511 / FAX: 81-52-653-3533, keiort@aol.com

treatment choice. Since 1995, patients with cervical radiculopathy (including spondylotic and discogenic) had been treated with intradiscal injection of steroid (IDIS) and selective nerve root block (SNRB) at our hospital. Here we retrospectively report the outcomes of these nonsurgical in a series of patients with cervical radiculopathy.

MATERIALS AND METHODS

In total, 289 patients with cervical radiculopathy were treated with IDIS and/or SNRB from 1995 to 2010, 161 patients (121 men, 40 women) who were followed up for >2 months were enrolled in this study. The institutional review board in our institution approved this study, and written informed consent was obtained from each patient before study participation or treatment. Their mean age was 50 years (range: 30–77 years). All patients had undergone prior conservative care equivalent imaging studies, typically myelography, computed tomography after myelography, and magnetic resonance imaging (MRI). The affected spinal root levels were C3-4, C4-5, C5-6, C6-7, C7-Th1, C5-6-7, and C6-7-Th1 in 3, 12, 56, 82, 5, 2, and 1 patient, respectively (Figure 1).

IDIS was performed using fluoroscopy, with patients in a supine position. The technique involved the use of a 23-guage spinal needle (Terumo Co.; Tokyo, Japan) inserted through an anterolateral approach in each patient. The internal carotid artery was palpated and then displaced laterally, whereas the esophagus and trachea were moved medially (toward the contralateral side) before inserting the needle. Needle -tip placement into the center of the disc was confirmed before intradiscal injection of 0.5 mL of the radiopaque dye iohexol (Omnipaque

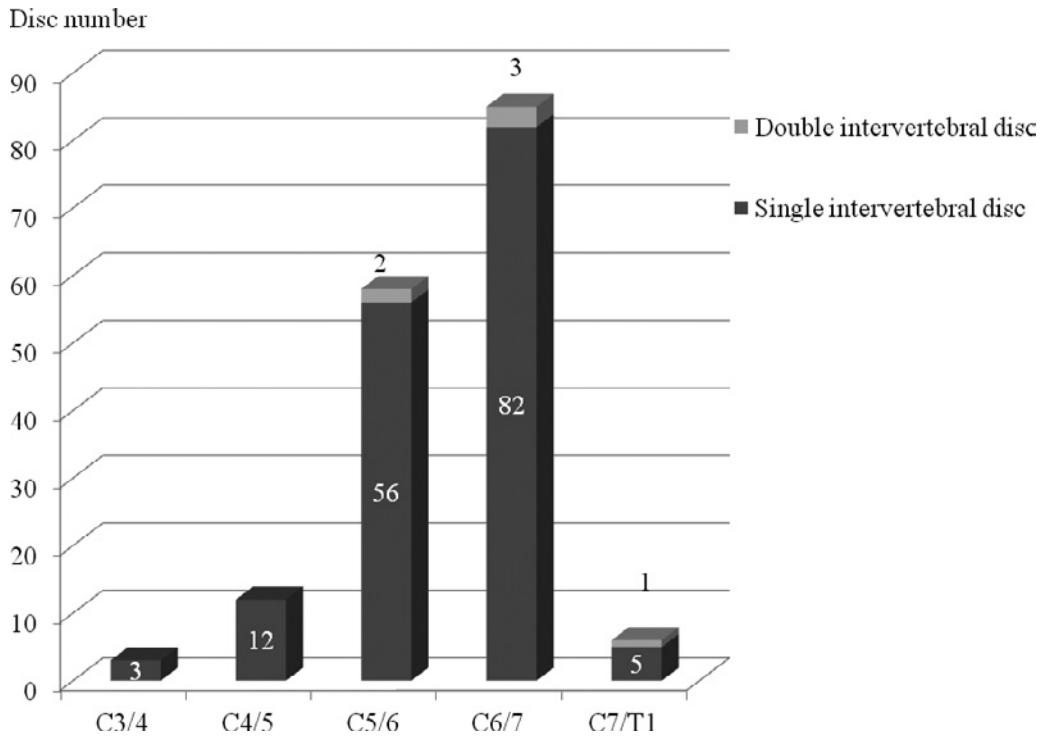

Fig. 1 Affected spinal cord levels

240mg/mL; Daiichi-Sunkyo Co.; Japan). After the needle position was documented by filming, approximately 1.0 mL of 1:1 mixture of steroid and a 2% lidocaine solution was injected. We used betamethasone-sodium-phosphate (Rinderon 0.4%; Shionogi & Co.; Japan).

Similarly, SNRB was performed using fluoroscopy, with patients in a supine position. The technique involved the use of a 23-gauge spinal needle inserted through an anterolateral approach in each patient. For SNRB, radicular pain was provoked, iohexol was injected to confirm the needle position, and the position was documented by filming. Subsequently, approximately 1.0 mL of 1:1 mixture of steroid and a 2% lidocaine solution was injected.

Patients' clinical manifestations were classified as arm pain, arm numbness, neck and/or scapular pain, and arm paralysis. Improvement in each manifestation was categorized as "disappeared," "improved," "poor," or "worsened." Arm pain occurred in 116 patients, arm numbness in 120, neck and/or scapular pain in 102, and arm paralysis in 17.

Final clinical outcomes were evaluated using Odom criteria,[4] which was used to divide the patients into 4 groups: "Excellent," "Good," "Satisfactory," and "Poor." The "Excellent" group comprised patients who had no complaints related to cervical disc disease and who were able to performed daily activities without impairment. The "Good" group comprised patients who had intermittent discomfort related to cervical disc disease, not significantly interfering with their work. The "Satisfactory" group comprised patients who had subjective improvement, but whose physical activities were significantly limited. The "Poor" group comprised patients whose condition did not improve or worsened before treatment. Responses of "disappeared" and "improved" manifestations were considered to indicate treatment effectiveness.

In total, 91 patients underwent repeated MRI, the average interval between the initial and final MRI was 6.4 months (range: 16 days–3.5 years). Changes in herniated disc size were evaluated by comparing the initial and final MRI scans. On the basis of the change, patients were divided into 3 groups: regression group, no-change group and progression group. We investigated the relationship between the Odom criteria and changes observed on MRI.

Data analysis was performed with Stat View 5.0 software (ABACUS; Berkeley, CA). Comparisons between the Odom criteria and changes observed on MRI were performed using analysis of variance and the chi-square test. A P -value of $< .05$ was considered significant.

RESULTS

Manifestations

Arm pain "disappeared" in 49 patients, "improved" in 54 patients, and was "poor" in 13 patients. No patient reported "worsened" arm pain. Arm numbness "disappeared" in 27 patients, "improved" in 65 patients, was "poor" in 28 patients. No patient reported "worsened" arm numbness. Neck and/or scapular pain "disappeared" in 31 patients, "improved" in 53 patients, was "poor" in 17 patients, and "worsened" in 1 patient. Arm paralysis "disappeared" in 6 patients, "improved" in 7 patients, "poor" in 3 patient, and "worsened" in 1 patient (Table1).

Effectiveness rates were 89% for arm pain, 77% for arm numbness, 82% for neck and/or scapular pain, and 76% for arm paralysis.

Odom criteria

Final clinical outcomes were grouped using the Odom criteria. The "Excellent," "Good," "Satisfactory," and "Poor" groups comprised 23, 84, 35, and 19 patients, respectively. Eleven patients (31%) in the "Satisfactory" group and 17 (89%) "Poor" group underwent surgery. No patient in "Excellent" or "Good" group underwent surgery. Despite being in the "Poor" group,

Table 1 Changes of Manifestation

	Disappeared	Improved	Poor	Worsened
Arm pain	49	54	13	0
Arm numbness	27	65	28	0
Neck and/or scapular pain	31	53	17	1
Arm paralysis	6	7	3	1

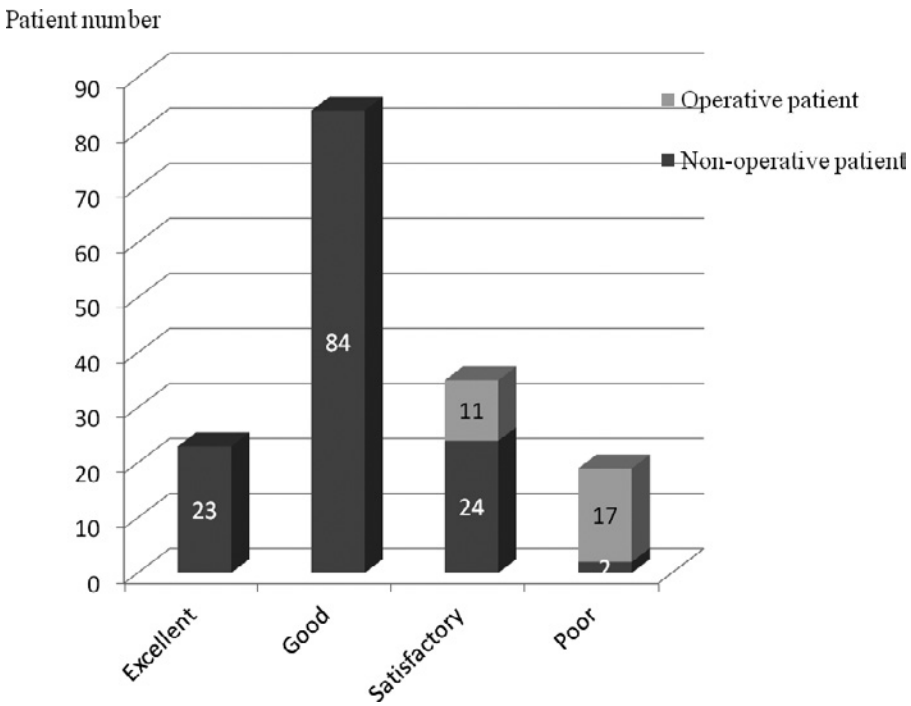

Fig. 2 Odom criteria

2 patients did not undergo surgery; 1 opted for conservative treatment, 1 was involved in traffic or industrial accidents (Figure 2).

MRI

In total, 91 patients underwent repeated MRI. In 56 patients (62%), the size of the herniated disc decreased on MRI, but disc size increased in 4 patients (4.4%). In addition, disc size in the remaining 31 patients (34%) exhibited no change. In the regression group, the Odom criteria were used to categorize 12 patients as "Excellent," 39 as "Good," and 5 "Satisfactory." Where no change in disc size (no-change group) was observed, the Odom criteria categorized 3 patients as "Excellent," 16 as "Good," 10 as "Satisfactory," and 2 as "Poor." In the progression group, 2 patients were categorized as "Excellent," 1 as "Good," and 1 as "Poor." In progression group, 1 patient as "Poor" was underwent surgery 4 months after IDIS and SNRB (Figure 3). And 1 patient as "Excellent" became discitis 2 weeks after IDIS.

"Excellent" and "Good" categories as indicators of good outcomes, we noted that 91% patients

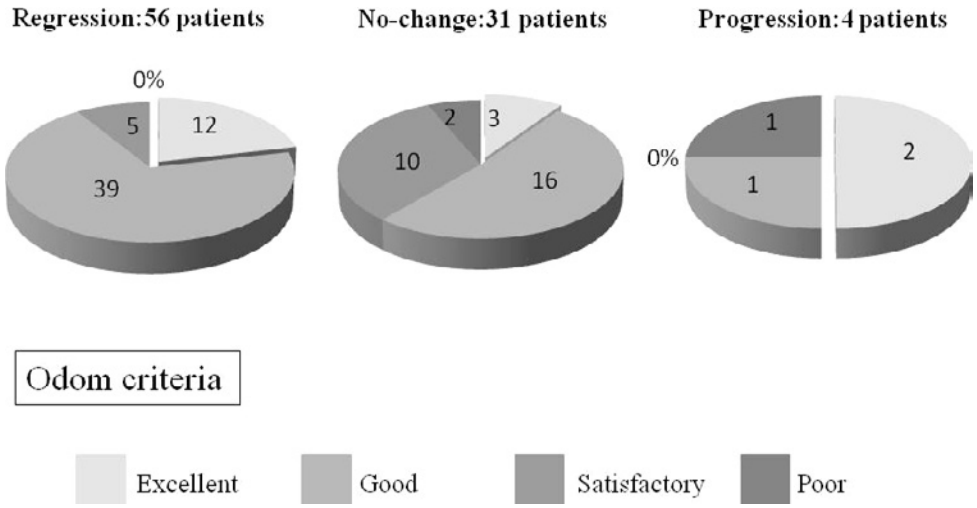

Fig. 3 Changes in herniated disc size and Odom criteria

in the regression group, 61% in the no-change group, and 75% in the progression group. The regression group showed significantly better Odom criteria results than the no-change group ($p<0.01$).

Surgical rate

Of the 161 patients, 156 underwent IDIS, and 104 underwent SNRB; 99 underwent IDIS and SNRB, 57 underwent IDIS alone, and 5 underwent SNRB alone. Ten patients experienced a recurrence of symptoms and underwent a nonsurgical second treatment. The average period for retreatment was 3.5 years (2.5 months–9.1 years). The average nonsurgical follow-up period was 7.1 months (2months–2.8 years). Twenty-three (14.3%) patients underwent surgery. The average period for surgery was 1.8 months (2 weeks–6.6 months). None of the 28 patients with a >1-yr follow-up underwent surgery.

Complications

After 156 IDIS injections, 1 case of discitis (0.6%) was reported. No serious complications occurred after SNRB injections.

DISCUSSION

In most patients with cervical radiculopathy, symptoms are usually self-limiting and resolve spontaneously over without specific treatment.[5] Hence, nonsurgical treatment should be the first choice for such patients. However, cervical radiculopathy sometimes induces severe and intolerable pain. IDIS and SNRB are suitable for such patients because they rapidly improve neuralgia. Steroids have an anti-inflammatory effect, and they decrease pain by stabilizing neural membranes and by imparting a direct anesthetic effect on small nonmyelinated nociceptive C fibers.[6, 7] Moreover, lidocaine reportedly reduces inflammation in nucleus pulposus-induced nerve root injuries and has leukocyte inhibitory activity.[8, 9] Lidocaine may improve blood flow and reduce neural dysfunction in injured nerve roots.[6, 7]

Cervical discography has a comparatively low incidence of complications.[8] The major complications of cervical disc injection are spinal cord injury, esophageal injury, thyroid gland puncture, and infection. The principal infectious complication is discitis, which reportedly occurs in 0.16%–3.2% patients.[10-13] Risk factors for discitis include having a beard, a short thick neck, and diabetes mellitus.[11-13] Lee *et al.* reported a safety zone for the percutaneous cervical approach in their dynamic imaging studies. They demonstrated that this approach resulted in a low risk of injury to pharyngoesophageal structures and considered it a safe diagnostic technique.[14] Cervical disc infections are rare in cervical SNRB, but there is a growing awareness of possible including spinal cord, brain stem, and cerebellar infarction. These infarctions have been reported to occur because of vertebral artery vasospasm, vertebral artery injury, embolism due to suspensions in the injected solution, or air embolism.[15-19] Guidelines describing the safe execution of cervical SNRB urge operators to place the needle posteriorly in the intervertebral foramen dorsal to the spinal nerve to avoid any arteries, based on the assumption that these vessels lie anterior to the spinal nerve.[20] In a 2005 report, Huntoon described the anatomy of the cervical intervertebral foramina and reported a risk at least a 1% for ischemic injury in the anterior spinal artery, even if the needle was inserted from the posterior aspect. No area of the foramen appeared to be safer than another with respect to potential arterial puncture or injection.[21] Although blood aspirations were negative, cannulation of the artery still occurred. In addition, positive blood aspiration has a specificity of 97%; however, it has a sensitivity of only 45.9%.[22, 23] We encountered 3 instances of contrast in the vertebral artery or vein in these procedures, but no complications occurred. It will be necessary to pay further attention to infusion after confirming the contrasting. In addition, water-soluble steroids should be used to avoid the formation of emboli from the suspension in SNRB injections.

In conclusion, IDIS and SNRB for cervical radiculopathy are not widely performed. However, other extremely effective therapies that can rapidly improve neuralgia should be considered as initial therapies before surgery.

CONFLICT OF INTEREST

Each author certifies that they had no commercial associations (e.g., consultancies, stock ownership, equity interest/licensing arrangement, etc.) that might pose a conflict of interest in connection with the submitted article.

REFERENCES

1) Slipman CW, Issac Z. The role of diagnostic selective nerve root blocks in the management of spinal pain. *Pain Physician*. 2001; 4: 214–226.
2) Tanaka N, Fujimoto Y, An HS, Ikuta Y, Yasuda M. The anatomic relation among the nerve roots, intervertebral foramina, and intervertebral discs of the cervical spine. *Spine*. 2000; 25: 286–291.
3) Mochida K, Komori H, Okawa A, Muneta T, Haro H, Shinomiya K. Regression of cervical disc herniation observed on magnetic resonance images. *Spine*. 1998; 23: 990–995.
4) Odom GL, Finney W, Woodhall B. Cervical disk lesions. *J Am Med Assoc*. 1958; 166: 23–28.
5) Bono CM, Ghiselli G, Gilbert TJ, Kreiner DS, Reitman C, Summers JT, Baisden JL, Easa J, Fernand R, Lamer T, Matz PG, Mazanec DJ, Resnick DK, Shaffer WO, Sharma AK, Timmons RB, Toton JF; North American Spine Society. An evidence-based clinical guideline for the diagnosis and treatment of cervical radiculopathy from degenerative disorders. *Spine J*. 2011; 11: 64–72.
6) Pobiel RS, Schellhas KP, Eklund JA, Golden MJ, Johnson BA, Chopra S, Broadbent P, Myers ME, Shrack K. Selective cervical nerve root blockade: prospective study of immediate and longer term complications.

AJNR Am J Neuroradiol. 2009; 30: 507–511.
7) Slipman CW1, Lipetz JS, Jackson HB, Rogers DP, Vresilovic EJ. Therapeutic selective nerve root block in the nonsurgical treatment of atraumatic cervical spondylotic radicular pain: a retrospective analysis with independent clinical review. *Arch Phys Med Rehabil*. 2000; 81: 741–746.
8) Anderberg L, Annertz M, Persson L, Brandt L, Säveland H. Transforaminal steroid injections for the treatment of cervical radiculopathy: a prospective and randomised study. *Eur Spine J*. 2007; 16: 321–8.
9) Yabuki S, Kawaguchi Y, Nordborg C, Kikuchi S, Rydevik B, Olmarker K. Effects of lidocaine on nucleus pulposus-induced nerve root injury. A neurophysiologic and histologic study of the pig cauda equina. *Spine*. 1998; 23: 2383–2389.
10) Connor PM, Darden BV 2nd. Cervical discography complications and clinical efficacy. *Spine*. 1993; 18: 2035–2038.
11) Grubb SA, Kelly CK. Cervical discography: clinical implications from 12 years of experience. *Spine*. 2000; 25: 1382–1389.
12) Guyer RD, Ohnmeiss DD, Mason SL, Shelokov AP. Complications of cervical discography: findings in a large series. *J Spinal Disord*. 1997; 10: 95–101.
13) Zeidman SM, Thompson K, Ducker TB. Complications of cervical discography: analysis of 4400 diagnostic disc injections. *Neurosurgery*. 1995; 37: 414–417.
14) Lee SH, Kim KT, Jeong BO, Seo EM, Suk KS, Lee JH, Lee GK. The safety zone of percutaneous cervical approach: a dynamic computed tomographic study. *Spine*. 2007; 32: E569–74.
15) Brouwers PJ, Kottink EJ, Simon MA, Prevo RL. A cervical anterior spinal artery syndrome after diagnostic blockade of the right C6-nerve root. *Pain*. 2001; 91: 397–399.
16) Ludwig MA, Burns SP. Spinal cord infarction following cervical transforaminal epidural injection: a case report. *Spine*. 2005; 30: E266–8.
17) Rosenkranz M, Grzyska U, Niesen W, Fuchs K, Schummer W, Weiller C, Röther J. Anterior spinal artery syndrome following periradicular cervical nerve root therapy. *J Neurol*. 2004; 251: 229–231.
18) Rozin L1, Rozin R, Koehler SA, Shakir A, Ladham S, Barmada M, Dominick J, Wecht CH. Death during transforaminal epidural steroid nerve root block (C7) due to perforation of the left vertebral artery. *Am J Forensic Med Pathol*. 2003; 24: 351–355.
19) Wallace MA, Fukui MB, Williams RL, Ku A, Baghai P. Complications of cervical selective nerve root blocks performed with fluoroscopic guidance. *AJR Am J Roentgenol*. 2007; 188: 1218–1221.
20) Baker R, Dreyfuss P, Mercer S, Bogduk N. Cervical transforaminal injection of corticosteroids into a radicular artery: a possible mechanism for spinal cord injury. *Pain*. 2003; 103: 211–215.
21) Huntoon MA. Anatomy of the cervical intervertebral foramina: vulnerable arteries and ischemic neurologic injuries after transforaminal epidural injections. *Pain*. 2005; 117: 104–111.
22) Furman MB, Giovanniello MT, O'Brien EM. Incidence of intravascular penetration in transforaminal cervical epidural steroid injections. *Spine*. 2003; 28: 21–25.
23) Verrills P, Nowesenitz G, Barnard A. Penetration of a cervical radicular artery during a transforaminal epidural injection. *Pain Med*. 2010; 11: 229–231.