KJP The Korean Journal of Pain
| Original Article |
Korean J Pain 2014 January; Vol. 27, No. 1: 43-48
pISSN 2005-9159 eISSN 2093-0569
http://dx.doi.org/10.3344/kjp.2014.27.1.43

Bipolar Intra-articular Radiofrequency Thermocoagulation of the Thoracic Facet Joints: A Case Series of a New Technique

Department of Anesthesiology, Division of Pain Medicine, Henry Ford Medical Center, Detroit, USA

David Kim

Background:

This study tests the hypothesis that of bipolar radiofrequency thermocoagulation of the thoracic facet joint capsule may provide a safe and effect method of pain control from thoracic facet origin.

Methods:

Among patients suffering from localized mid back pain, nine patients with thoracic facet disease confirmed by magnetic resonance image and diagnostic thoracic facet block were enrolled. Bipolar radiofrequency ablation in the inferior aspect of the thoracic facet joint was done. Visual Analog Scale (VAS) was measured pre-intervention and 1 month post-intervention. Any complications and changes in amount of pain medication were recorded.

Results:

Significant 47.6% reduction in VAS was noted at 1 month. There were no serious complications.

Conclusions:

Intra-articular bipolarradiofrequency thermocoagulation of the thoracic facet joint may be a technically easier and valid method of treating mid back pain of thoracic facet origin. (Korean J Pain 2014; 27: 43-48)

Key Words:

facet, radiofrequency, thermocoagulation, thoracic.

INTRODUCTION

Chronic mid back pain is a less commonly seen that low back pain. Linton et al. did a population based survey of spinal pain in 35–45 years olds with thoracic pain at 15% [1]. Of the many causes of mid back pain the thoracic facet joint may be a possible pain generator. It was first proposed as a source of pain by Wilson in 1987 [2]. The joint itself is a synovial joint which on animal models has shown extensive innervations [3]. Dissection studies of the

Received October 7, 2013. Revised December 2, 2013. Accepted December 5, 2013.
Correspondence to: David Kim
Department of Anesthesiology, Division of Pain Medicine, I-3 Pain Clinic, Henry Ford Medical Center, 2799 West Grand Blvd, Detroit Michigan 48202, USA
Tel: +1-313-622-7107, Fax: +1-313-916-8023, E-mail: Dkim1@hfhs.org

thoracic facet joints have shown in humans to be innervated from the medial branch of the dorsal rami above and below the facet joint [4]. Unlike the lumbar medial branches, the course of the medial branch in the thoracic tends to be variable depending on the thoracic level (Fig. 1, 2). Unlike the medial branch in the lumbar spine, the medial branch in the thoracic spine lays in the space between the transverse processes as it passes dorsally. It then courses over the lateral end of the superior border of the transverse process before entering the muscle compartment of the mid back. This typical course is seen at the T1–T3 and T9–T10. The T11 and T12 medial branch, due to the shortened transverse process, tends to hug the base of the superior articulate process more like a typical lumbar spine. At the T4–T8 level, the medial branch is located in the soft tissue between the transverse process and therefore does not have as consistent skeletal landmark to place a radiofrequency cannula for ablation as other vertebral body levels (Fig. 1, 2) [4,5]. Two studies have used radiofrequency thermocoagulation (RFTC) of the medial branch for thoracic pain with moderate benefit [6,7]. Literature for using bipolar intra-articular RFTC for large synovial joints such as the sacroiliac joint may point to a technically easier mode of treatment [8,9]. This pilot study attempts to see if bipolar RFTC is possible safe and effective technique for denervating the thoracic facet joint.

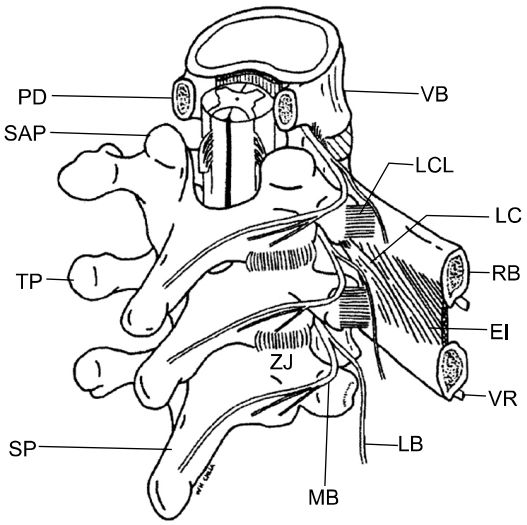

Fig. 1. Illustration of medial branch (MB) and lateral branch (LB) thoracic spine. Bogduk N (ed). Practice Guidelines for Spinal Diagnostics and Treatment Procedures. International Spine Injection Society (ISIS) 2004. Reproduced with permission of the publishers. PD: pedicle, VB: body of vertebra, SAP: superior articular process, LCL: lateral costovertebral ligament, LC: levator costorum, TP: transverse process, RB: rib, EI: external intercostal muscle, ZJ: zygaphophysial joint, VR: ventral root, SP: spinous process.

MATERIALS AND METHODS

After IRB approval, 9 patients were selected to have bipolar RFTC. These patients had localized mid back tenderness with pain on extension and lateral bending with no radicular symptoms. All patients had MRI's showing facet disease, no disc extrusions, and no cord/root compromise. These levels were injected with 1 ml of a solution containing 9 ml of 0.5% marcaine mixed with 40 mg of depomedrol using anterior/posterior (AP) intra-articular approach as outlined in the International Spine Intervention Society (ISIS) guidelines [6]. Each injection was confirmed after injection of 0.5 ml of isovue-m300 contrast producing an arthrogram. Patients who received at least > 50% relief for 8 hours were enrolled in the study. One month later, two Baylis (RFK Baylis, Baylis Medical, ON, Canada) 20 gauge 10 cm curved radiofrequency cannulas with 5 mm active tips were guided by fluoroscopy into the inferior portion of the facet joint using the ISIS approach. Each cannula was placed side by side in the inferior aspect of the thoracic facet joint 0.5 cm apart (Fig. 3). Confirmation of cannula placement was noted on lateral view (Fig. 4). Motor testing was done at 2.5 volts and 2 Hz with no rad-

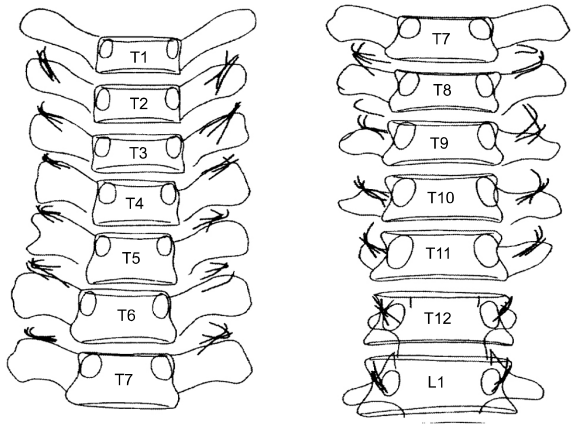

Fig. 2. Illustration of variation of position of medial branch in thoracic spine. Bogduk N (ed). Practice Guidelines for Spinal Diagnostics and Treatment Procedures,. International Spine Injection Society (ISIS) 2004. Reproduced with permission of the publishers.

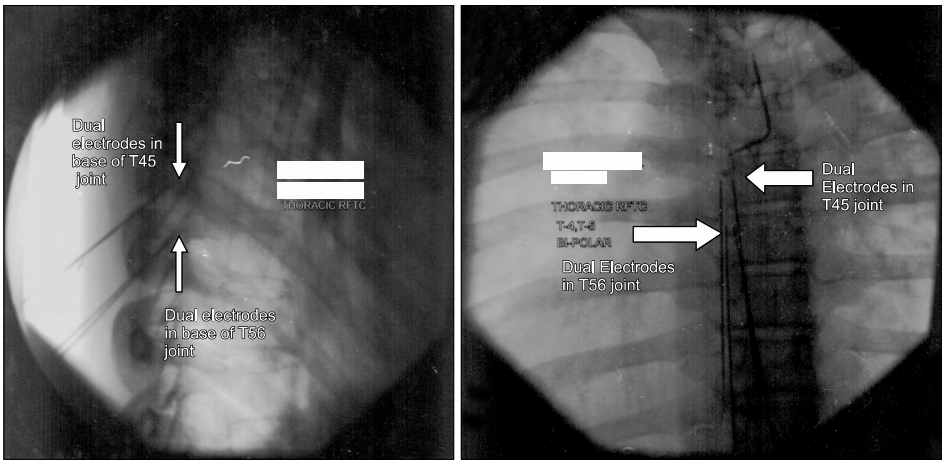

Fig. 3. Lateral and AP views of bipolar RFTC at left T4-5 and T5-6 facet joints. Note pairs of electrodes side by side approximately 5 mm apart in the inferior aspect of each joint.

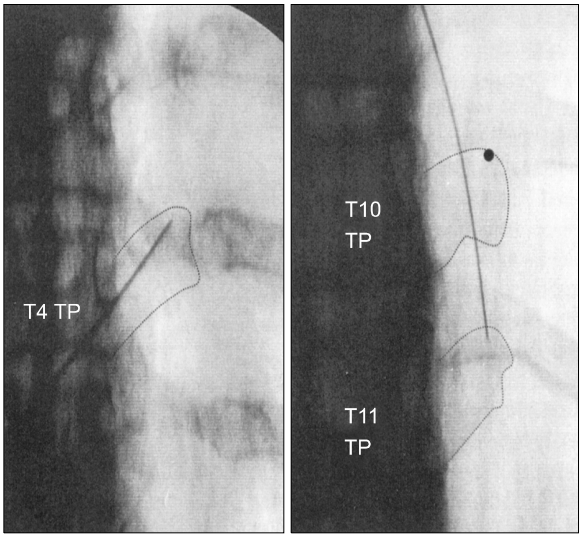

Fig. 4. Medial branch block T3 and T10 at the lateral end of superior border of the transverse process using opposite oblique orientation to see the superior tip of the transverse process: the "Pinnochio" view. Bogduk N (ed). Practice Guidelines for Spinal Diagnostics and Treatment Procedures. International Spine Injection Society (ISIS) 2004. Reproduced with permission of the publishers.

icular symptoms noted. Then each site underwent bipolar radiofrequency at 80 degrees for 90 second through a Baylis radiofrequency generator (RF Cosman G4, Baylis Medical, ON, Canada). VAS measurements were obtained pre-RFTC and one month later as well as being asked about changes in pain medication use.

RESULTS

A total of 9 patients were enrolled in the study (Table 1). The mean age was 49.6 (18-70). The genders of the patients were as follows: 77.8% (N = 7) female and 22.2% (N = 2) male. 77.9% (N = 7) of patients had the ablations performed unilaterally versus 22.2% (N = 2) performed bilaterally. Of the 7 patients who had unilateral ablation, 5 had two joints ablated and 2 had three joints ablated. There was a significant reduction in VAS at 1 month follow up with mean change of −47.6% (P = 0.028). Six out of nine patients (66%) noted relief from 100%-60% reduction of VAS with average 80.4% reduction. Three out of nine patients who did not report pain relief had the following change in VAS: +33.3%, +14.29%, and +6.25%. Three patients (33.3%) reported decrease in their pain medication intake while 66.7% (N = 6) noted no change. No patients reported increase in medication use and no serious complications were reported.

DISCUSSION

Pain from thoracic facet joint does pose a challenge in both diagnosis and treatment. Lintons's population survey found prevalence of mid back pain in general 15% [1]. Manchikanti et al. in 2002 estimated the prevalence of facet joint pain in chronic thoracic pain to be 48% using two medial branch block using lidocaine and marcaine [10]. They studied again facet joint pain using medial branch blocks for chronic spine pain in general and found facet injection response in the thoracic spine 42%, cervical spine 55%, and lumbar spine 31% [11]. Subsequent randomized double blind controlled trial by Manchkanti et al. compared marcaine versus marcaine/depomedrol in patients who had positive responses to diagnostic blockade [12]. He found

Table 1. Case Series of Thoracic Facet Radiofrequency Thermocoagulation

Subject	A	B	C	D	E	F	G	H	I
Age/Sex	56/M	62/F	22/F	52/M	55/F	65/F	18/F	70/F	46/F
Side	R	L	B	L	L	L	B	R	R
Level	T5-T7	T7-T9	T4-T6	T6-T8	T6-T9	T2-T4	T6-T7	T11-L1	T2-T5
Preop VAS (mm)	80	60	80	70	100	50	40	70	80
Postop VAS (mm)	5	80	0	22	40	20	0	80	85
Medication	↓	→	↓	→	→	→	↓	→	→
VAS change (%)	−93.7	33.3	−100	−68.6	−60	−60	−100	14.3	6.3

Side of radiofrequency thermocoagulation; R: right, L: left, B: both, Medication; ↓: decreased, →: no change.

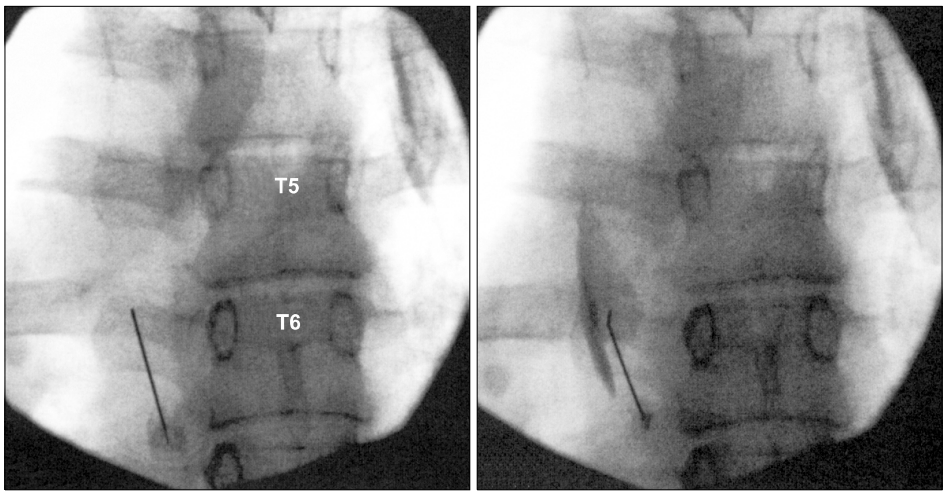

Fig. 5. Medial branch block left T5 above superior aspect of tip of left T6 transverse process. Bogduk N (ed). Practice Guidelines for Spinal Diagnostics and Treatment Procedures. International Spine Injection Society (ISIS) 2004. Reproduced with permission of the publishers.

significant pain relief and improvement on the Oswestry Disability Index in 79% of patients at 3–12 months in patients who received marcaine. In the depomedrol/marcaine group, he noted 83%, 81%, and 79% at 3, 6, and 12 months respectively. The author also performed a prospective study on 55 patients who received medial branch block with steroid found 71% receiving > 50% relief at 3 and 6 months, 76% at 12 months, 71% at 24 months, and 69% at 36 months [13]. The thoracic medial branch follows a variable course without great contact with boney landmarks especially in T4–T8 level. The technique to block the medial branch is well documented in the International Spine Injection Society (ISIS) guidelines based on anatomic dissection by Chua et al. [4,5]. The target for the T1–T4 and T9–T10 medial branch would the dorsal aspect of the transverse process opposite the lateral end of superior border of the transverse process (Fig. 4). Many times because the transverse process is short the fluoroscope needs to be in the opposite oblique orientation to see the superior tip of the transverse process better known as the "Pinnochio" view (Fig. 4). For the T5–T8 medial branch there is no standard studied technique. The ISIS guidelines propose using an AP view to the transverse process and bevel the spinal needle cephalad. Injection of contrast to see spread between the intertransverse spaces confirms correct placement (Fig. 5). The other approach would be to contact the transverse process to gauge depth and slip it superior so it lies in the in the inter–transverse space. Stolker et al. [14] studied cadavers to see how accurate fluoroscopy was in placing a needle probe in the thoracic dorsal root ganglion as a target. The needle tip was found to be in the DRG 60.9% of the time and in the extradural dorsal root 30.4%. However 8.7% of the time no neural tissue was contacted indicating fluoroscopy is relatively accurate for blockade. This relative accuracy may not meet the smaller tolerances for RFTC cannula placement. Two studies have looked at RFTC of the medial branch of the thoracic facet joints. The first by Stolker et al. in 1993 involved 40 patients with thoracic back pain [7]. The diagnosis was made by clinical exam and local anesthetic block

of the medial branch. After 12 months 47% patients were pain free, 35% had > 50% pain reduction, but 17.5% had no relief. 12.5% of patients had significant postoperative pain. Tzann et al. analyzed 118 monopolar RFTC's performed on cervical, thoracic and lumbar regions on 90 subjects [6]. 17 procedures were done in the thoracic level with 2 of the procedures repeated. All the patients had successful diagnostic blockade and were followed post-ablation for 1-33 months with success defined as greater than 50%. Success in the thoracic region was 40% with one procedure only. Our present study using bipolar rftc demonstrated higher percentage of subjects (66%) with significant pain relief and a average reduction of VAS of 80.4% (Table 1).

The intra-articular approach offers an easier alternative to medial branch block and ablation. Intra-articular thoracic facet injection was done first by Wilson in 1987 [2] and subsequently reviewed by Dreyfuss et al. and Bogduk et al. [15,16]. It is well described in the ISIS guidelines using the AP and lateral view [17]. Dreyfus et al. and Fukui et al. injected the facet joints and described typical referral patterns of pain [18,19]. A later article by Fortin described a modified bent needle technique which may make entry easier [20]. From anatomic dissection of the facet joint done by McLain et al. normal facet joints found encapsulated nerve endings in 40% of the thoracic capsules versus 60% of the capsules sampled [21]. The junctional zone between the capsule proper and paraspinal muscles were particularly well innervated with large and small nerve fascicles penetrating from the capsular margin. This would make bipolar strip ablation at the inferior portion of the capsule a readily simple way to partially denervate the facet joint.

Bipolar ablation using two adjacent radiofrequency cannulas has been successfully used to denervate the sacroiliac joint [8,9]. Monopolar ablation uses a grounding pad and an uninsulated treatment cannula from which flows RF energy at 300 Hz to heat surrounding tissue in an ovoid pattern around the exposed tip. In bipolar ablation, a second cannula completes the circuit and due to the small surface area and large current provides a second site of tissue coagulation. Pino et al. evaluated the morphology of bipolar ablation at 2 mm, 4 mm, 6 mm, 8 mm, and 10 mm apart in egg whites and found the electrodes need to be less than or equal to 6 mm to create a contiguous strip lesion [22]. These small distances are ideal for the small area of the thoracic facet joints.

In conclusion, bipolar radiofrequency ablation by placement of RFTC cannulas in the inferior aspect of the thoracic facet joint may be easier and viable method of treating mid back pain due to facet disease. Minimally because the cannulas take an AP approach and maintain the cannulas closer medially over the lamina, this theoretically decreases the risk of pneumothorax and gives easily targeted bone landmarks. As this pilot shows, this technique may give significant pain relief without significant complication. The study is limited by small number and no placebo controlled protocol. Further study with higher volume of patients is warranted.

REFERENCES

1. Linton SJ, Hellsing AL, Halldén K. A population-based study of spinal pain among 35-45-year-old individuals. Prevalence, sick leave, and health care use. Spine (Phila Pa 1976) 1998; 23: 1457-63.
2. Wilson PR. Thoracic facet joint syndrome — a clinical entity? Pain 1987; 30 Suppl 1: S87.
3. Stilwell DL Jr. The nerve supply of the vertebral column and its associated structures in the monkey. Anat Rec 1956; 125: 139-69.
4. Chua WH, Bogduk N. The surgical anatomy of thoracic facet denervation. Acta Neurochir (Wien) 1995; 136: 140-4.
5. Bogduk N; International Spine Intervention Society, Standards Committee. Thoracic medial branch blocks. In: Practice guidelines for spinal diagnostic and treatment procedures. San Francisco (CA), International Spine Intervention Society. 2004, pp 330-47.
6. Tzaan WC, Tasker RR. Percutaeous radiofrequency facet rhizotomy--experience with 118 procdedures and reappraisal of its value. Can J Neurol Sci 2000; 27: 125-30.
7. Stolker RJ, Vervest AC, Groen GJ. Percutaneous facet denervation in chronic thoracic spinal pain. Acta Neurochir (Wien) 1993; 122: 82-90.
8. Ferrante FM, King LF, Roche EA, Kim PS, Aranda M, Delaney LR, et al. Radiofrequency sacroiliac joint denervation for sacroiliac syndrome. Reg Anesth Pain Med 2001; 26: 137-42.
9. Wedley JR, Gauci CA. Handbook of clinical techniques in the management of chronic pain. In: Sacroiliac joint denervation. Langhorne (PA), Harwood Academic. 1994, pp 12-3.
10. Manchikanti L, Singh V, Pampati V, Beyer CD, Damron KS. Evaluation of the prevalence of facet joint pain in chronic thoracic pain. Pain Physician 2002; 5: 354-9.
11. Manchikanti L, Boswell MV, Singh V, Pampati V, Damron KS, Beyer CD. Prevalence of facet joint pain in chronic spinal pain

of cervical, thoracic, and lumbar regions. BMC Musculoskelet Disord 2004; 5: 15.
12. Manchikanti L, Singh V, Falco FJ, Cash KA, Pampati V. Effectiveness of thoracic medial branch blocks in managing chronic pain: a preliminary report of a randomized, double-blind controlled trial. Pain Physician 2008; 11: 491-504.
13. Manchikanti L, Manchikanti KN, Manchukonda R, Pampati V, Cash KA. Evaluation of therapeutic thoracic medial branch block effectiveness in chronic thoracic pain: a prospective outcome study with minimum 1-year follow up. Pain Physician 2006; 9: 97-105.
14. Stolker RJ, Vervest AC, Ramos LM, Groen GJ. Electrode positioning in thoracic percutaneous partial rhizotomy: an anatomical study. Pain 1994; 57: 241-51.
15. Dreyfuss P, Tibiletti C, Dreyer S, Sobel J. Thoracic zygapophyseal joint pain: a review and description of an intra-articular block technique. Pain Digest 1994; 4: 46-54.
16. Bogduk N, April C, Derby R. Diagnostic blocks of the synovial joints. In: Spine care Vol. 1 Diagnosis and conservative treatment. Edited by White AH. St. Louis, Mosby. 1995, pp 298-321.
17. International Spine Intervention Society, Standards Committee. Practice guidelines for spinal diagnostic and treatment procedures. Edited by Bogduk N. San Francisco (CA), International Spine Intervention Society. 2004, pp 314-29.
18. Dreyfuss P, Tibiletti C, Dreyer SJ. Thoracic zygapophyseal joint pain patterns. A study in normal volunteers. Spine (Phila Pa 1976) 1994; 19: 807-11.
19. Fukui S, Ohseto K, Shiotani M. Patterns of pain induced by distending the thoracic zygapophyseal joints. Reg Anesth 1997; 22: 332-6.
20. Fortin JD, McKee MJ. Thoracic facet blocks: bent needle technique. Pain Physician 2003; 6: 513-6.
21. McLain RF, Pickar JG. Mechanoreceptor endings in human thoracic and lumbar facet joints. Spine (Phila Pa 1976) 1998; 23: 168-73.
22. Pino CA, Hoeft MA, Hofsess C, Rathmell JP. Morphologic analysis of bipolar radiofrequency lesions: implications for treatment of the sacroiliac joint. Reg Anesth Pain Med 2005; 30: 335-8.