Journal of Clinical Neuroscience 30 (2016) 39–43

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Clinical Study

Percutaneous bipolar radiofrequency thermocoagulation for the treatment of lumbar disc herniation

Zhenhua Zeng [a,*], Min Yan [b], Yi Dai [a], Weidong Qiu [b], Shuo Deng [a], Xinzhu Gu [a]

[a] Department of Pain, Jishan First People's Hospital of Zhejiang Province, No. 1218 South Tiyu Road, Luoxing Street, Jiashan 314100, China
[b] Department of Pain, Second Affiliated Hospital of Zhejiang University, Hangzhou, China

ARTICLE INFO

Article history:
Received 29 June 2015
Accepted 25 October 2015

Keywords:
Efficacy
Bipolar radiofrequency thermocoagulation
Lumbar disc herniation
Targeted ablation

ABSTRACT

Lumbar disc herniation is usually managed with conservative treatment or surgery. However, conservative therapy seldom yields good results, and surgery is associated with multiple complications. This study aimed to assess bipolar radiofrequency thermocoagulation for the treatment of lumbar disc herniation. A total of 168 patients with lumbar disc herniation suitable for radiofrequency thermocoagulation were enrolled and randomized to monopolar radiofrequency thermocoagulation (control group, n = 84) or bipolar radiofrequency thermocoagulation (experimental group, n = 84) treatment groups. Ablation sites were targeted under CT scan guidance, and consecutive radiofrequency therapy was used. One and two probes were used for monopolar and bipolar thermocoagulation, respectively. Thermocoagulation was achieved at 50°C, 60°C, and 70°C for 60 s each, 80°C for 90 s, and 92°C for 100 s. Symptoms and complications were evaluated using the modified Macnab criteria and Visual Analog Scale at 7, 30, and 180 days postoperatively. At 180 days, a significantly higher efficacy rate was obtained in the experimental group compared with control patients (91.6% *versus* 79.7%, $P < 0.05$). No severe complications were occurred in either group. Targeted ablation via bipolar radiofrequency thermocoagulation is efficient for lumbar disc herniation treatment, and should be further explored for broad clinical application.

1. Introduction

As a common cause of low back and leg pain, lumbar disc herniation is usually treated with conservative therapy or surgery [1–3]. However, conservative therapy seldom succeeds, and surgery is associated with deficiencies such as neurological trauma, slow healing, long recovery times, postoperative complications such as spinal instability, adhesion and scarring, and even failed back surgery syndrome in severe cases [4]. Recently, technological advances in minimally invasive spine surgery have emerged [5,6]. Common minimally invasive (percutaneous) techniques include hemodiscolysis with chymopapain, Onik's automated percutaneous lumbar discectomy, percutaneous laser disc decompression, intradiscal electrothermal therapy, percutaneous coblation nucleoplasty, Dekompressor percutaneous lumbar discectomy (Stryker, Kalamazoo, MI, USA), and intradiscal oxygen-ozone therapy [7,8]. These techniques include two surgical approaches, namely intradiscal decompression and extradiscal ablation [9–11].

Radiofrequency (RF) thermocoagulation is a minimally invasive approach recently used for lumbar disc herniation. A RF electrode produces an electric field, breaking down the covalent bonds maintaining the three dimensional structure of collagen, shrinking collagen and reducing intradiscal pressure, and ablating the nociceptors that extend into the annulus fibrosus, preventing nerve growth and reducing the stimulation from intervertebral disc degenerative tissues to the nerves [12,13]. Monopolar RF thermocoagulation is a classic method in lumbar disc herniation treatment [14]. Bipolar RF thermocoagulation is a more recent technique, and produces a more intense and concentrated heat than the monopolar version; indeed, it can concentrate heat in the area between the two electrodes by creating an electromagnetic field using the current changes. Reports assessing targeted ablation using bipolar RF thermocoagulation for the treatment of lumbar disc herniation are scarce. This study aimed to assess bipolar RF thermocoagulation for its efficacy in the treatment of lumbar disc herniation.

2. Methods

2.1. General information

This prospective randomized cohort study was approved by the Ethics Committee of Jiashan First People's Hospital of Zhejiang

* Corresponding author. Tel.: +86 139 6730 0927; fax: +86 21 6408 5875.
E-mail address: zzh20150520@126.com (Z. Zeng).

http://dx.doi.org/10.1016/j.jocn.2015.10.050
0967-5868/

Province, China. Patients provided written informed consent, and received RF thermocoagulation for the treatment of lumbar disc herniation between March 2006 and June 2013. Using a random number table, patients were randomized into the control (monopolar) or experimental (bipolar) RF thermocoagulation groups.

2.2. Inclusion and exclusion criteria

Inclusion criteria were patients aged ⩾18 years, diagnosed with lumbar disc herniation, who had nerve root irritation with or without low back pain, and remained symptomatic after 6 weeks of conservative treatment such as oral medication, physical therapy, and nerve block. Patients with dysfunction of any vital organ, or imaging findings of calcified, prominent or massive disc prolapse, lumbar spine deformity, or spinal stenosis were excluded.

2.3. Operative technique

In both monopolar and bipolar RF thermocoagulation procedures, patients were placed in the prone position with a soft cylindrical pillow to straighten the back. According to previous imaging and the clinical symptoms and signs, the CT scanning level was determined. After scanning, the intervertebral space for RF ablation was selected and the target site for RF thermocoagulation determined. After measuring the penetration length and angle on CT images, the CT guidance laser was placed onto the patient's lumbar skin. Target site positions were measured with a ruler to determine whether the sites were located at the medial or lateral edge of the facet joint and marked according to measurements on CT images. After routine disinfection, sterile towels were placed. Guided by CT scans, the protrusion was punctured with a puncture needle for the RF probe. One probe was used for monopolar RF thermocoagulation and two probes placed within 1 cm of each other were used for bipolar thermocoagulation (Fig. 1). Upon electrode insertion into the puncture needle, sensory and motor response tests were carried out to assess nerve injury or neurological deficit. Sensory responses were assessed at 100 Hz and 3 mA to record any aggravated numbness or pain in the lower extremities; motor responses were evaluated at 2 Hz and 3 mA to detect any muscle spasm. No response indicated a safe distance between the puncture needle and nerve root. In case of sensory and/or motor responses, the puncture was redone. No signs of neurological deficit or nerve injury were observed. After the puncture was confirmed to be in the protrusion by CT scan, the RF treatment was carried out using the Leksell LNG30-1 (Elekta AB, Stockholm, Sweden).

For monopolar RF thermocoagulation, a sterile RF electrode was inserted into the puncture probe. After confirming the absence of nerve root irritation, thermocoagulation was applied at 50°C, 60°C, and 70°C for 60 s each, and 80°C for 90 s with no rest time between temperature changes. At this point, the "warm feeling" of pain at the original pain site (the target site), should be duplicated. If the warm feeling was not duplicated, the depth and direction of the puncture probe were adjusted. If at this time the patient had a burning sensation in the lower limb nerve distribution area, the puncture was advanced 2 mm deeper and three cycles of 100 s at 92°C was applied. For patients with intervertebral disc herniation of more than 0.5 cm, the puncture was advanced approximately 1.5 mm further to perform three cycles at 92°C; for individuals with two or more targets in an intervertebral disc herniation wider than 1.0 cm, the distance between targets should not exceed 1 cm.

In bipolar RF thermocoagulation, the positioning for the first RF puncture probe was the same as described above. The second RF puncture probe was inserted into the intervertebral disc via the medial or lateral edge of the facet joint (Fig. 2, 3), according to the location of the protrusion; after CT scan confirmation that the distance between the proximal ends of the two probes was ⩽1.0 cm, the sensory and motor nerves were assessed using the monopolar electrode. After ruling out nerve root irritation, the main electrode was inserted into the protrusion and consecutive thermocoagulation was applied at 50°C for 60 s, 60°C for 60 s, 70°C for 60 s, 80°C for 90 s, and 92°C for 100 s.

2.4. Assessment of clinical efficacy

A single-blinded method was adopted, with the doctors performing follow-up and efficacy assessment unaware of treatment type. All follow-up and efficacy assessments were completed by a doctor who was not involved in the surgical or therapeutic process. The efficacy was assessed using the modified Macnab criteria [6]: excellent outcome = disappearance of symptoms, complete recovery in working and sporting activities, and disappearance of

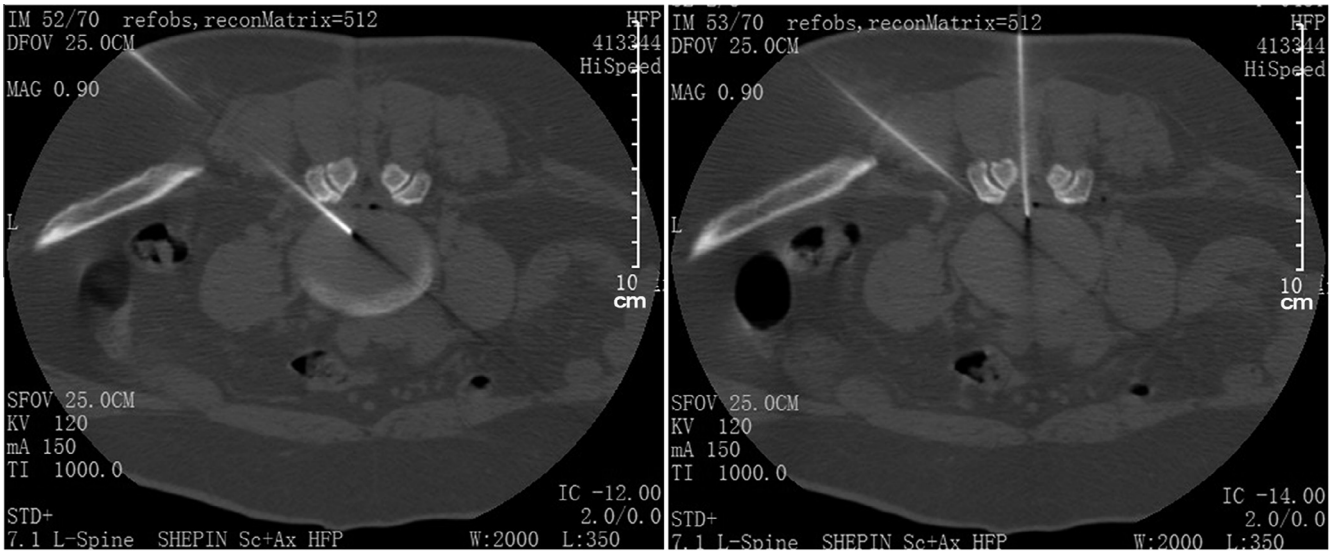

Fig. 1. Axial CT scan with bone windows shows punctures from the medial and lateral edges of the left facet joint.