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ARAŞTIRMA / RESEARCH

Pulsed and conventional radiofrequency thermocoagulation applications on low back pain

Bel ağrısında pulsed ve konvansiyonel radyofrekans termokoagulasyon uygulamaları

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Abstract

Purpose: Nowadays, low back pain (LBP) is an important health problem. Radiofrequency (RF) treatments can generate different temperature levels by transferring energy to the targeted tissue, and which is an effective interventional treatment method for LBP patients. In this study, we compared the effects of pulsed and conventional RF treatments on patients with LBP.

Materials and Methods: Thirty patients with LBP histories for longer than three months received pulsed (42 0C, 240 s) (n=15) and conventional (65 0C, 120 s) (n=15) RF treatments. The baseline and one and three months after the procedure, the patients' pain and disability values were obtained using a Visual Analogue Scale (VAS) and the modified Oswestry Disability Index (ODI), respectively. The results of the patients' neurological examinations were also recorded.

Results: The VAS and modified ODI values were reduced in both groups one and three months after the RF treatments when compared to the baseline values However, no statistically significant differences were found between the two groups. In addition, there were no statistically significant differences between the two groups in terms of the neurological examination results involving motor, sensorial, and reflex losses.

Conclusion: The pulsed and conventional RF treatments exhibited similar effects in the LBP patients. Therefore, higher temperatures do not provide an advantage. Pulsed RF treatment applied to the dorsal root ganglion is a safe and effective way to avoid possible side effects.

Keywords: Low back pain, pulsed radiofrequency treatments, dorsal root ganglion.

Öz

Amaç: Günümüzde bel ağrısı önemli bir sağlık sorunudur. Radyofrekans (RF) tedavisi, hedeflenen dokuya enerji transferi ile farklı sıcaklık seviyeleri üretir ve bel ağrısına sahip hastalarda etkin bir tedavi yöntemi olabilir. Bu çalışmada, lumbar bel ağrısına sahip hastalarda arka kök ganglionuna uygulanan pulsed ve konvansiyonel radyofrekansın etkilerinin karşılaştırılması amaçlandı.

Gereç ve Yöntem: Bu çalışma için üç aydan daha uzun süre bel ağrısına sahip 30 hasta kabul edildi, pulsed (42 0C, 240 s) (n=15) ve konvansiyonel (65 0C, 120 s) (n=15) radyofrekans uygulandı. Hastaların işlem öncesi ve işlem sonrası 1 ve 3. aylarda ağrıları Visual Analog Skala (VAS) ve fonksiyonel aktiviteleri modifiye Oswestry Disability İndeks (ODİ) ile değerlendirildi. Nörolojik muayeneleri kaydedildi.

Bulgular: Her iki grupta VAS ve modifiye ODİ değerleri 1. ve 3. aylarda işlem öncesine göre istatistiki olarak anlamlı derecede düşüktü. Ancak iki grup arasında istatiksel farklılık bulunmadı. Motor, sensoryal ve refleks kaybı değerlendirdiğimiz nörolojik muayenede gruplar arasında fark yoktu.

Sonuç: Bel ağrısına sahip hastalarda uygulanan pulsed ve konvansiyonel radyofrekans yöntemleri benzer etkilere sahipti. Daha yüksek dereceler avantaj sağlamamaktadır. Olası yan etkilerden kaçınmak için dorsal kök ganglionuna uygulanan pulsed radyofrekans güvenli ve etkin bir yöntemdir.

Anahtar kelimeler: Bel ağrısı, pulse radyofrekans tedavisi, arka kök ganglion.

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INTRODUCTION

Low back pain (LBP) is an important worldwide health problem, with more than 70 % of the population experiencing it at least once during their lifetimes. Lumbar radicular pain (LRP) occurs in 5 - 10 % of the individuals with LBP. Radicular pain occurs as a result of irritation, damage, or inflammation in the dorsal root ganglion (DRG), which is the underlying mechanism of LRP[1-2]. Both invasive and noninvasive treatment methods are available for patients with chronic LRP. The noninvasive methods include pharmacology, manual therapy, exercise therapy, and educational therapy and psychological therapies, and the invasive methods include steroid injections, nerve blocks, cryoablation, and radiofrequency (RF) thermocoagulation[3].

Many studies have reported that RF therapy is an effective option for treating severe chronic pain, such as trigeminal neuralgia, cervical radicular pain, LRP, and complex regional pain syndrome [2, 4]. RF treatments can generate different temperature levels by allowing energy transfer to the targeted tissue. Although the conventional RF (CRF) treatments were first described in the early 1950s, they have been used by clinicians to treat pain in certain anatomical locations since the beginning of the 1980s. In the CRF technique, tissue destruction occurs with electrode tip temperatures reaching 60 - 80 ^{o}C[5]. Van-Kleef et al. reported that an RF treatments of the DRG at 67 ^{0}C in patients with chronic cervicobrachial pain resulted in a 2-point reduction in the Visual Analogue Scale (VAS)[6]. Pulsed RF (PRF) treatment developed later as an alternative to CRF treatment; however, unlike CRF treatment, PRF treatment is administered at 42 ^{o}C, maintaining the structural integrity of the tissue [5]. Tsou et al. stated that PRF treatment administered at the L2 level of the DRG is safe and effective for patients with chronic LBP[7]. In the literature, PRF treatment of the DRG is often used to treat LRP[2, 8-11]. However, in this context, CRF treatment is used less often. In the current study, we compared the effects of PRF and CRF treatments on LRP.

MATERIALS AND METHODS

After obtaining approval from the Local Ethics Committee for this prospective randomized study, we recruited 30 patients with LRP. Written informed consent was obtained from each patient. The inclusion criteria were as follows: the patients with aged between 20 and 70 years old, chronic LRP lasting for more than 3 months, leg pain with less intense back pain, and previous treatment modality failures, such as physiotherapy, lumbar surgery, and analgesic treatments. The exclusion criteria were as follows: coagulation abnormalities, injection site infections, malignancies, metabolic and fracture-related pain, radiopaque contrast media allergies, local anesthetics allergies, pregnancy, and inadequate communication.

Procedures

After a six-hour preoperative fasting time, each patient was brought into the operating room. Routine patient monitoring was performed, including electrocardiography, peripheral pulse oximetry, and noninvasive blood pressure monitoring. The patient was placed in a prone position, and all of the procedures were performed under sterile conditions. The marking was done by the practitioner under anterior-posterior fluoroscopic guidance using C-arm, and then, the skin and subcutaneous tissue were infiltrated with 5 ml of 1 % lidocaine. The needle (10 cm, 22 gauge, 5 mm active electrode) was introduced to the dorsal root ganglion within the intervertebral foramen under fluoroscopic guidance, and the electrode position was confirmed using a radiopaque contrast medium. The correct positioning of the RF electrode was adjusted using stimulation at 50 Hz up to 1 V for sensorial and motor stimulation. After injecting the local anesthetic (2 % lidocaine), 42 ^{0}C PRF therapy was performed for 240 s in the PRF group and 65 ^{0}C CRF therapy was performed for 120 s in the CRF group [8, 12]. At the end of the RF interventions in both groups, 10 mg of methylprednisolone and 5 % levobupivacaine for a total dose of 3 ml was injected, and the needle was removed. In the postoperative unit, each patient was evaluated for one hour after the procedure; then, he or she was discharged from the hospital.

Evaluation

The demographic data, pain status, smoking status, sports activity participation, trauma exposure, and previous treatment modalities of the patients and the results of their neurological examinations were recorded. At the baseline and one and three months after the procedure, the patients' pain scores were assessed using a VAS (0 cm = no pain; 10 cm = worst pain), and their modified ODI values were recorded[13]. The modified ODI includes 10 items,

which are each scored from 0 to 5 points for a total score of 50 points (0-10 points signifies mild disability, 11-20 points signifies moderate disability, 21-30 points signifies severe disability, 31-40 points signifies crippled, and 41-50 points signifies bed bound and unable to move about)[14].

Statistical analysis

All of the analyses were performed using IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, NY, USA). The categorical variables were expressed as the number and percentage, and the continuous variables were summarized as the mean and standard deviation. Either the Student's t test or Mann-Whitney U test was used to compare the continuous variables between two groups. The Friedman test was used to compare two groups with repeated measures. The chi-squared test and Mc Nemar's test were used to compare the categorical variables between the groups. The values were considered to be statistically significant when the P value was < 0.05.

RESULTS

The demographic data (age, gender, height, and weight) was similar between the two groups ($P > 0.05$) (Table 1). In addition, no differences were found between the two groups in terms of the patients' educational levels, trauma histories, smoking statuses, physical activity levels, daily activities, and symptom durations ($P > 0.05$). Seventy percent of the patients had lumbar and leg pain. Twenty patients received one level of thermocoagulation, and 10 patients received two levels. Thirty patients underwent unilateral treatment at the L3 level or lower. The treatment modalities that the patients received before their RF procedures are shown in Table 2.

Table 1. Demographic data

	Group PRF (n = 15)	**Group CRF (n =15)**	**P value**
Age	43.7 ± 13.9	49.8 ± 10.8	0.17
Gender (F/M) *(n)*	5/10	7/8	0.45
Height (cm)	160.7 ± 10.1	163.6 ± 6.4	0.62
Weight (kg)	73.9 ± 12.6	73.3 ± 11.6	0.89
Symptoms *(%)*			
Low back pain Lower limb pain Low back pain with lower limb pain	2 (13.3) 1 (6.7) 12 (80)	2 (13.3) 4 (26.7) 9 (60)	0.32
Duration of symptoms (months)	42.2 ± 66.3	53.6 ± 58.5	0.62

Data are presented as number, percentage, and mean ± standard deviation.

Table 2. The incidence of treatment modalities before procedure

	Group PRF (n = 15)	**Group CRF (n = 15)**	**P value**
Operation	7 (46.7)	6 (40.0)	0.71
Physical therapy	7 (46.7)	5 (33.3)	0.45
Myorelaxant drug	5 (33.3)	5 (33.3)	1.00
NSAIDs	9 (60)	11 (73.3)	0.43
Antidepressant drug	2 (13.3)	0 (0.0)	0.14

Data are presented as number and percentage.
NSAIDs: non-steroidal inflammatory drugs

The VAS values were significantly higher at the one and three-month follows ups than they were at the baseline in both groups ($P < 0.05$). However, the VAS values were similar between the groups at all of the time points. Although the modified ODI values in both groups were decreased one and three months after the procedure when compared to the baseline values, there was no differences between the groups at any of the time points (Table 3). Moreover, no statistically significant differences were found in terms of the neurological examinations.

Table 3. VAS and modified ODI values

	Baseline	1 month	3 months	P value
VAS				
Group I (n = 15)	7.9 ± 1.5	5.2 ± 1.9	4.3 ± 2.5	0.00[a]
Group II(n = 15)	8.3 ± 1.4	5.1 ± 2.2	4.3 ± 3.5	0.00[a]
P value	0.54	0.72	0.85	
Modified ODI				
Group I (n = 15)	26.1 ± 7.3	19.5 ± 8.4	18.7 ± 9.9	0.02[a]
Group II(n = 15)	26.5 ± 7.3	20.4 ± 8.6	16.3 ± 13.1	0.00[a]
P value	0.80	0.90	0.48	

Data were presented as mean ± standard deviation.; [a]Before procedure compared to after procedure of each group; VAS: Visual Analogue Score; ODI: Modified Oswestry Disability Index

DISCUSSION

In the present study, we evaluated the effects of PRF and CRF treatments on the VAS and modified ODI values in patients with LBP. Our results showed that the PRF and CRF treatments had similar effects with regard to pain and disability reduction during the three months following the treatment.

The LBP treatment approaches include medical therapy, physical therapy, surgery, and percutaneous invasive methods. In our study, the patients had been treated previously using medical therapy, physical therapy, or surgery. However, the patients' clinical responses were negative; therefore, RF thermocoagulation was performed in these patients.

One possible RF mechanism of action is that the nociceptive input may be decreased by the coagulation of a small part of the DRG without provoking a sensorial defect. In a multicenter randomized controlled study, Geurtz et al. demonstrated that CRF treatment of the lumbar DRG was not superior to local anesthetic injections during three-month follow up [10]. Similarly, another study reported that the CRF treatment had poor outcomes when they were used to reduce cervicogenic headaches, when compared with local anesthetic infiltration around the greater occipital nerve[15]. Contrarily, van Kleef et al. performed CRF treatment on the DRG in patients with cervical pain, and they found that the CRF treatment was effective, with decreased pain scores in 75 % of the patients during the first three months[16]. PRF treatment consists of the intermittent administration of a high frequency current, and they are performed at temperatures not exceeding 42 ^{0}C[17]. One retrospective study reported that the application of PRF adjacent to the lumbar DRG in patients with lumbosacral radicular pain attenuated the pain and additional analgesic requirement[17]. The same authors later published a cohort study in which they stated that PRF treatment applied to the DRG may be effective in patients with lumbosacral pain[18]. However, Simopoulos et al. compared PRF treatment (42^{0}C for120 s) and the combination of CRF (56^{0}C ± 8^{0}C for 60 s) and PRF treatments to treat lumbosacral radicular pain. The results showed that the PRF and CRF combination treatment was not superior to the PRF treatment in terms of pain relief[12]. Similar to that study, we showed that the VAS and modified ODI values were similar between the CRF and PRF treatments for LRP.

Some animal studies have shown that PRF treatment has less neurodestructive effects when compared to CRF treatment[19-20]. Although it is known that CRF treatment may damage neural structures, Slappendel et al. compared the pain reducing effects of CRF treatment applied at 40 ^{0}C and 67 ^{0}C in patients with cervicobrachialgia, and they reported similar findings using the two temperatures, without complications [21]. In clinical practice, it may be said that PRF treatment is the preferred method due to the lesser potential of neural tissue damage than CRF treatment[2,5,9]. However, in the present study, we did not find any complications, including sensorial and motor deficits, in the PRF and CRF groups.

The present study has limitations. First, the sample size was small. Second, the RF treatment and steroid injection combination had the potential to provide long-term pain relief and to reduce the first signs of RF treatment-related discomfort [22-23]. However, in this study, only the patients' short-term results (3 months) were evaluated; we did not document the initial discomfort (during the first 24 h) and the long-term effects (> 1 years) of the RF treatments.

In conclusion, the CRF treatment in the LBP patients showed results similar to those of the PRF treatment. However, to avoid possible neurological

complications, we believe that PRF treatment can be more useful and safer method for LBP patients.

Yazar Katkıları: Çalışma konsepti/Tasarımı: HÖ, ZH; Veri toplama: ZH; Veri analizi ve yorumlama: ZH; Yazı taslağı: ZH; İçeriğin eleştirel incelenmesi: HÖ; Son onay ve sorumluluk: ZH, HÖ; Teknik ve malzeme desteği: HÖ; Süpervizyon: HÖ; Fon sağlama (mevcut ise): yok.
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