Clinical observation of pulsed radiofrequency in treatment of knee osteoarthritis

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Abstract: Objective: To investigate the clinical effect of intra-articular pulsed radiofrequency on the pain caused by refractory knee osteoarthritis. Methods: 42 cases of patients (totally 67 knees) suffering the pain caused by severe knee osteoarthritis were randomly divided into two groups: group C and group R. Group C was treated with intra-articular injection of compound betamethasone; Group R was treated with intra-articular pulsed RF. Visual analogue scale (VAS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC index), clinical effect and recurrence rate during follow-up, adverse reactions as well as the changes of tumor necrosis factor (TNF-α), matrix metalloproteinase-3 (MMP-3) and interleukin-1 (IL-1) in synovial fluid of both groups were recorded at pre-treatment and 1, 4, 8, 12, 24 weeks after treatment respectively. All collected data were analyzed by SPSS 11.5 software.

Results: Comparing with pre-treatment scores, the VAS and WOMAC scores at 1, 4, 8, 12 and 24 weeks after treatment were decreased significantly in both groups with group C significantly higher than group R; The total effective rate was 95.5% in group R comparing with 85.5% in group C, and there was significant difference between the two groups. After treatment, the recurrence rate of group C was significantly higher than that of group R, with statistical difference. No obvious adverse reactions occurred in all patients. After treatment, the content of TNF-α, MMP-3 and IL-1 in the synovial was significantly reduced in the patients of group R, and the reduced volume was significantly higher than that of group C, with significant difference. Conclusion: the effect of intra-articular pulsed RF treatment is obviously superior to the traditional compound betamethasone injection group in the treatment for refractory knee osteoarthritis; pulsed RF could obviously alleviate the clinical symptoms and decrease the content of TNF-α, MMP-3 and IL-1 in the synovial, in addition, it is safe and reliable, all of these make it an effective method for senile refractory knee osteoarthritis.

Keywords: Knee osteoarthritis, knee joint cavity, pulsed radiofrequency

Introduction

Knee osteoarthritis, as a common chronic disease in the elderly, is a serious public health problem in the world. Studies have showed that people over 65 years old with symptomatic knee osteoarthritis accounts for 20-30% of the elderly population [1]. The main clinical symptoms are chronic articular pain on knee, dysfunction, depression mood, and decreased quality of life. The conventional conservative treatments of knee osteoarthritis include physical therapy, medication, intra-articular corticosteroid injections (IACIs), and intra-articular injection of hyaluronic acid etc. Although conservative treatment is effective in most patients with arthritis, the effects are not ideal in some patients with refractory osteoarthritis. Total knee arthroplasty is an effective treatment for refractory knee osteoarthritis [2]. However, some elderly patients with many other complications couldn’t or do not want to accept the high risks of surgery. Exploring a more appropriate treatment to alleviate the pain of those patients is the goal of our study. Pulsed RF, as a commonly used technique for clinical treatment of painful diseases, has been reported to be used in the treatment of intra-articular pain disorders in recent years [3, 4]. Karaman et al. [5] using intra-articular pulsed radiofrequency to treat 31 patients with knee osteoarthritis was proved to be effective, however, since then there was no report on the treatment of intra-articular pulsed radiofrequency. Due to the high safety of pulsed RF and easy operation of knee joint, this study further explored the efficacy of
pulsed radiofrequency in the treatment of refractory pain in knee osteoarthritis.

Methods

General information

42 patients diagnosed of chronic osteoarthritis were selected in this study, including 14 males and 28 females. The patients aged from 56 to 81 years old (average age was 68±9.5 years old) and weighted from 47 to 87 kg (average weight was 62.5±15.3 kg); there were 17 cases of unilateral knee joint pain and 25 cases of bilateral knee pain, and the duration of disease was more than 3 months; the VAS of patients ranged from 4 to 8 points (7.16±1.38 points for average). Patients were treated with non steroidal anti-inflammatory drugs (NSAIDs), however, the therapeutic effect was poor, and some patients even couldn’t tolerate, that seriously influenced the quality of life. Patients with acute pain, connective tissue disease, severe cardiopulmonary insufficiency or neurological and psychiatric disease were excluded. No patients had abnormal coagulation or peri-patellar tissue infection, or treated with intra-/extra-articular corticosteroid injection within 3 months. Patients were randomly divided into two groups: compound betamethasone injection group (Group C, 20 cases, 32 joints), and pulsed radiofrequency treatment group (Group R, 22 cases, 35 joints).

Treatment methods

Patients in group C were treated with injection of compound betamethasone at the point EX-LE 4 (neixiyan) and point ST35 (waixiyan). Compound mixture: 2 ml 2% lidocaine and 0.5 ml compound betamethasone were diluted by physiological saline to 4 ml; 2 ml for each injection point.

Pulsed RF was used in group R. Patients were in supine position with knee flexed to approximately 120°, and pillows were used to support the flex position; point EX-LE 4 (neixiyan) and point ST35 (waixiyan) were chosen as puncture points. After routine disinfection, appropriate amount of 0.5 ml 1% lidocaine was used for local anesthesia, then a 10 cm No.22 RF needle with 1 cm working end was used to puncture at point ST35 (waixiyan), the puncture depth was approximately 3-4 cm into the articular cavity, and then 2 ml physiological saline was injected to confirm the entering of articular cavity if there was no resistance. Connect the RF needle to radio frequency instrument, set temperature at 42°C; pulsed RF with 2 Hz and pulse width of 20 ms was applied for 120 seconds * 3 cycles, a total of 6 minutes, then pull out the needle. Repeat the above procedures on point EX-LE 4 (neixiyan). All patients did not take other analgesic drugs.

Observation indicators

VAS, WOMAC index and adverse reactions of patients were recorded at pre-treatment and 1, 4, 8, 12 and 24 weeks after treatment.

VAS score: the pain level was scaled from 0-10 points, Patients pointed out the picture of facial expression while they suffering from the pain, and the physician recorded the relevant scores behind the picture. 0 point for pain free and 10 points for unbearable pain; 1-4: mild pain, 5-7: moderate pain, 8-10: severe pain.

Western Ontario and McMaster Universities Osteoarthritis Index, also named as WOMAC index: [6]: it includes 24 questions, among them, 5 relate with arthralgia, 2 relate with anchylosis, and 17 relate with joint physiologic function. Each question has five levels with 0~4 points, 0 = none, 1 = mild, 2 = moderate, 3 = serious and 4 = very serious. Each symptom was comprehensively evaluated at pre-treatment and 1, 4, 8, 12 and 24 weeks after treatment.

Criteria for judging therapeutic effect

The criteria for the evaluation of therapeutic effect: clinical cure: no pain on knee joint, range of motion of knee joint was basically normal, no tenderness reaction, the total WOMAC score ranged 0-1; significant effectiveness: symptoms of knee osteoarthritis basically disappeared or significantly relieved, range of motion was increased significantly, no tenderness reaction, total WOMAC score decreased ≥ 2/3; effectiveness: symptoms of knee osteoarthritis was partially relieved, range of motion was increased, tenderness reaction was weakly positive, and total WOMAC score decreased ≥ 1/3; invalid: relief of symptoms and signs were not in the criteria mentioned above, the total score of the WOMAC decreased < 1/3. After 3 months, all patients (except invalid) were followed-up.
Detection of cytokines in synovial fluid

At pre-treatment and 1 week after the treatment, 1 ml synovial fluid of two groups of patients were extracted and stored in sterile EP tube at -20°C. The content of TNF-α, MMP-3 and IL-1 in the synovial fluid samples was measured strictly according to the steps in the operation manual.

Statistical analysis

Data were analyzed using SPSS 11.5 statistical software. Measurement data were expressed with mean ± standard deviation (X ± SD); comparison of WOMAC, VAS scores in two groups of patients before and after treatment was analyzed by t test. Ridit analysis was used to compare the ranked data. Enumeration data were expressed with percentage and compared by chi-square test. P < 0.05 indicates statistically significant difference.

Results

General information

Two groups of patients (20 cases in group C and 22 cases in group R) showed no statistically significant differences in age, body weight, gender, duration of disease, and pre-treatment VAS score and WOMAC score (P > 0.05), see Table 1.

Comparison of total therapeutic effect between two groups

The overall effective rate in group R was significantly higher than that of group C. The clinical effect of the two groups was analyzed by Ridit, showing that there were significant differences (u = 2.05, P = 0.03 < 0.05), from which we can see that the curative effect of two groups in improving the total symptoms is significantly different, see Table 2.

Comparison of follow-up results between two groups

After 3 months’ follow-up of the patients in two groups (except the patients with invalid effect), the results showed that there were 7 cases and 10 cases of recurrence in group R and group C, respectively. The difference between the two groups in recurrence rate had statistical significance (χ² = 11.812, P < 0.05), see Table 4.

Complications of adverse reactions

Knee joint dropsy in patients of group R (3.72±1.23 ml) within 2 weeks after the treatment was less than that of group C (15.68±3.15 ml) (t = 17.42, P < 0.05). No obvious puncture infection, sensory disturbance of lower extremities and other serious complications were observed in two groups of patients.

Detection of cytokines in synovial fluid between two groups

The content of TNF-α, MMP-3 and IL-1 was compared between the two groups at pre-treatment...
(P > 0.05), the result showed that the two groups were comparable with no statistically significant differences. After the treatment, the content of 3 cytokines mentioned above was significantly decreased in both groups (P < 0.05). The content of the 3 cytokines in group R decreased more sharply than that of group C with statistical significance. Visibly, both two treatments have clinical efficacy on knee osteoarthritis, but pulsed RF was significantly better than compound betamethasone injection, as shown in Table 5.

**Discussion**

Among the conservative treatments for knee osteoarthritis, drug treatment is the foundation, and the intra-articular injection of compound betamethasone is an internationally recognized traditional treatment for patients refractory to medical therapy [7, 8]. So, this study used the intra-articular injection of compound betamethasone as the control group to observe the curative effect.

Radio frequency has been widely used in analgesia. There are many reports about the use of standard radiofrequency to damage the peripheral nerves of knee both in domestic and abroad [9, 10]. But the method is tedious in the process, the peripheral nerve branch of knee are so many and not fixed, the failure rate is high in finding the nerves, moreover, partial loss of sensation after neural damage leads to the discomfort of the patient. The major source of the pain caused by knee osteoarthritis is unknown, therefore, there is no reliable study to confirm that the pain on knee could be completely eliminated after damaging the knee peripheral nerves; the intra-articular structures, including synovial membrane, capsule, and ligament, may have considerable responsibility for the pain caused by knee osteoarthritis [11-13]. Compared with the standard RF, the electric current of pulsed RF is generated in the pulsed mode, the maximum temperature of therapeutic electrode does not exceed 42°C; it retains the integrity of structure and function of Aδ nerve fiber under the circumstance of blocking nociceptive impulses of Aδ and C fiber. There are a lot of reports on pulsed radiofrequency in treating all kinds of joint cavities [14, 15], at present, there are some articles and case reports on using pulsed RF in the intra-articular treatment at abroad [16, 17]. Based on previous studies, our department compared pulsed RF with the traditional method to verify its effectiveness.

Inflammation may be an important feature in the process of knee osteoarthritis. Pain associ-
Treatment of knee OA with pulsed RF

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