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Radiofrequency Ablative Therapy in The Treatment of Chronic Vertebrogenic Pain

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1. Abstract

Back pain is not only human suffering, but also great socio-economic loss. According to epidemiological studies conducted in countries with developed economies and medicine, more than 70% of patients at the initial appointment complain of malaise associated with spinal disease. This is due to the wide prevalence of pathological conditions of the spine, referred to by doctors as osteochondrosis, spondyloarthrosis, spondylosis, etc. In recent decades, doctors of various specialties have significantly increased their interest in the problems of vertebrogenic pain, methods for studying it, methods of prevention and treatment. On the one hand, the development of new instruments, implants, and methods of surgical correction of a pathologically altered spine allows surgery to be at the top of technological progress, and on the other hand, a vertebrologist today is faced with the problem of choosing the optimal method of surgical treatment for the patient.

2. The Aim of the Study

Surgical intervention for vertebrogenic pain is now almost exclusively reduced to spondylodesis (spinal fusion). However, in December 2001, the published the results of a prospective randomized study. 294 patients with chronic pain of degenerative etiology were examined, excluding cases of specific x-ray diagnoses such as spondylolisthesis. In this study, it was found that in patients who received surgical treatment in the form of spinal fusion, 2 years after surgery, the functional assessment was lower, and the pain score was higher than in non-operated patients.

In light of this, the question arises of the advisability of performing volumetric surgical interventions in patients with vertebrogenic pain.

Over the years, a number of minimally invasive methods have been proposed for the treatment of spondylogenic pain syndrome by destroying nervous tissue, including the method of Radiofrequency Denervation (RFD). This method is currently an alternative to traumatic medical interventions on the cervical, thoracic and lumbar spine in patients with vertebrogenic pain and the ineffectiveness of conservative therapy.

3. Materials and Methods

We observed 245 patients (150 women and 95 men) aged 21 to 69 years (average age 54.3 years). The reason for visiting a doctor was complaints of pain in the cervical (18 patients), thoracic (19 patients) and lumbar (208 patients) spine. All patients underwent radiological examination, including X-ray of the spine in two projections (in cases of pain in the neck and lumbar pain, functional tests were additionally performed), in doubtful cases, MRI or CT of the affected area was prescribed to exclude disco-radicular conflict. In the case of degenerative changes in the intervertebral discs and joints, x-ray revealed subchondral sclerosis of the vertebral endplates, a decrease in the height of the intervertebral space, sclerosis and deformation of the articular surfaces, a violation of their congruence, and an uncovertebral arthrosis may develop.

The intensity of the pain syndrome was assessed using a pain audit card, the maximum pain level in which corresponds to 100 points.

The patients also underwent a study of the biomechanics of the cervical and lumbar spine using the three-dimensional motion analyzer Zebris 3-D MotionAnalyzer (Zebrismedizintechnik, Germany). Patients were found to have impaired biomechanics of the cervical and lumbar spine, which was expressed in the limitation of extension and asymmetry in the amplitude of oblique and rotational movements.

Based on the clinical and x-ray examination in these groups of patients, it was found that the cause of the pain syndrome was degenerative changes in the facet (arcuate) joints, *i.e.*the diagnosis was formulated as spondyloarthrosis of certain segments (in the cervical region, segments from C3 to C6 (97%) were more often affected, in the thoracic region - from Th5 to Th12 (96%), in the lumbar region - segments L3-4, L4-5, L5 -S1 (97%). Reduction or complete relief of pain after paraarticular diagnostic blockade with 2% lidocaine solution at the level of the lesion made it possible to finally establish that the pain comes from the compromised joint.

Given the fact that not all clinicians recognize the role of the pathology of the intervertebral joints in the genesis of back pain, it is necessary to dwell on more detail on the clinic of the "facet-syndrome". Often the onset of pain is associated with extension and rotation of the spine and other torsion overloads. All patients in the group with disease of the cervical spine have pain (sometimes very pronounced) and limitation of movement. The pain often radiates to the shoulder girdle, shoulder joint and shoulder. Unlike radicular pain caused by compression of the corresponding nerve by a herniated disc, pain should not be localized in the forearm and fingers. Examining the patient, attention is drawn to the forced position of the head, the asymmetry of the shoulder girdle, the tension of the paravertebral and collar zone muscles on one or both sides. As a rule, movements in the cervical spine are limited, especially extension and rotation of the head. With an isolated lesion of the intervertebral joints, the doctor will not find pathological changes in the reflex and sensory spheres on the upper limbs. Pain emanating from the facet joints of the thoracic and lumbar spine is lateralized, diffuse, difficult to localize, sclerotomy in nature and, as a rule, does not go below the knee. It is limited to the thoracic or lumbosacral region above the corresponding facet joint, radiating to the gluteal region and upper thigh (with lumbar localization). Facet pain can be more or less cramping, aggravated by prolonged standing, extension, especially if it is combined with tilt or rotation to the affected side, when changing body position from lying to sitting and vice versa. Characterized by the appearance of short-term morning stiffness and an increase in pain by the end of the day. Unloading the spine - its slight flexion, the adoption of a sitting position, the use of support (stand, railing) - reduces pain. Physical examination can reveal flatness of the lumbar lordosis, rotation or curvature of the spine in the thoracic, thoracolumbar or lumbosacral

regions, tension in the paravertebral muscles and/or square muscle of the back on the affected side, muscles of the popliteal fossa, hip rotators. On palpation local pain of the facet joint is characterized. As a rule, there are no neurological sensory, motor and reflex disorders. The symptoms of "stretching" of the nerve roots, restriction of movements as such are also not characteristic. Sometimes, in chronic cases, some weakness of the rectifiers of the spine and the muscles of the popliteal fossa is revealed. Pain from the L5-S1 joint is reflected in the coccyx, hip joint, back of the thigh, sometimes in the groin. Irritation of the L4-5 joint is characterized by pain radiating from the site of irritation to the buttock, back of the thigh and hip joint and, only occasionally, to the coccyx. From the L3-4 joint, the pain spreads to the chest region, the lateral surface of the abdomen, the groin, reaches the anterior surface of the thigh and, very rarely, the coccyx and perineum. Irritation of the facet joints of a higher level (Th12-L1, L1-2, L2-3) is limited to the appearance of pain in the upper back and abdomen, chest and even in the cervical regions. Pain from Th3-4-5 joints often radiates to the interscapular, subscapular region.

All patients underwent conservative treatment on an outpatient basis. The therapeutic complex included drug treatment (non-steroidal anti-inflammatory drugs, vitamin therapy, biostimulants, etc.), para-articular blockades - for diagnostic and therapeutic purposes (with the obligatory administration of steroid drugs - diprospan 1.0 ml), physiotherapy, massage, corset therapy, psychotherapy. With insufficient effectiveness of conservative therapy or a short duration of the effect, patients underwent radiofrequency destruction of the facet nerves. Taking into account the peculiarities of the clinical manifestations of degeneration of the intervertebral joints, we identified the following indications for isolated radiofrequency destruction of the facet nerves: prolonged pain in the cervical/thoracic/lumbar spine (more than 6 months); exacerbation of pain in the spine after extension and rotation of the head / trunk, prolonged fixed position of the head / trunk (for example, working on a computer); increased pain in the spine with deep palpation of the joints; no signs of root compression (neurological deficit); lack of improvement after physiotherapy; significant reduction of pain in the neck / lower back after para-articular blockade at one or more levels; compliance of the clinic with x-ray findings (spondyloarthrosis); pain intensity on the scale of pain audit more than 15 points.

We also identified general contraindications for RFD: dependence on narcotic and sedative drugs, alcohol, the presence of social and psychological factors that determine the perception of pain, age younger than 18 and older than 80 years, previous spinal surgery, history of spinal circulation disorders.

The manipulation was performed in the operating room. In the position of the patient on the abdomen with RFD at the thoracic and lumbar levels and on the back when performing RFD at the cervical level, under local anesthesia with a solution of novocaine 0.5% - 10.0 ml under the control of an electron-optical converter, a puncture of the paraarticular region in the area of the nerves was performed going to the joint capsule. As a rule, a puncture was performed simultaneously at three to four levels.The position of the needle was controlled in two projections .

Then,to identify the correct position of the needle, using the radio frequency generator Stryker InterventionalspineMultiGen RF Console or the RFG-3C PLUS generator from RADIONICS, electrical stimulation of the facet nerves was performed at a frequency of 50 Hz. The patient should have experienced tingling sensations in the area of the corresponding facet joint between 0.4 and 0.6 V. The frequency was then reduced to 2 Hz and muscle contractions were observed in the limbs, the absence of which indicated the correct position of the electrode. For the purpose of anesthesia, a 0.5% solution of novocaine (no more than 2.0 ml) was injected into the area of the alleged destruction, and the actual radiofrequency destruction was carried out.

Patients tolerated manipulation well. Within thirty minutes after denervation, they were on bed rest, during which time anti-inflammatory therapy was carried out (Xefocam 8 mg/m). Then the patients were allowed to get up. Patients were discharged under outpatient supervision by a neurologist on the same day. At the outpatient stage rehabilitation treatment was carried out (therapeutic gymnastics of the upper and lower extremities), anti-inflammatory therapy. Within 46 weeks, the exclusion of heavy physical and sports activities was recommended. Patients were advised to start work 7-14 days after the procedure.

The results of treatment of patients with radiofrequency denervation were compared with the results of conservative treatment of patients with spinal spondylarthrosis. This group included 106 patients (64 women and 42 men) aged 24 to 65 years. 8 patients were treated for pain in the cervical, 9 - in the thoracic, 89 - in the lumbar spine. The complex of conservative treatment included the use of medications: NSAIDs (diclofenac, meloxicam, lornoxicam), muscle relaxants (mydocalm), antidepressants, vitamins. All patients underwent physiotherapy, therapeutic physical culture, massage.

4. Results

We did not notice any complications either during the operation, or in the early or late postoperative periods. After radiofrequency destruction for 1-2 weeks, in 79% of cases, patients continued to complain of a feeling of heaviness in the area of manipulation about a significant decrease in the intensity of the pain syndrome. After 3-6 weeks, this feeling disappeared.

We evaluated the effect of denervation before the patient was discharged to work, after 1 month, 6 months, 1 year and 1.5 years from the moment of RFD.

The results of the manipulation were divided into three groups: good - no pain, satisfactory - no pain at rest, a significant decrease in its intensity during movements, no need to take analgesics, and unsatisfactory - maintaining the intensity of the pain syndrome at the same level.

When evaluating the results in the early period after the manipulation, in all cases, a decrease in pain syndrome was noted, on average, by 36 points on the pain audit scale, both in the corresponding section of the spine and in the extremities. A month later, a good outcome of the disease was noted in 101 (41%) patients, a satisfactory outcome in 137 (56%) patients, and an unsatisfactory outcome in 7 (3%) patients. Thus, a month after the manipulation, improvement occurred in 97% of patients. After 6 months, the distribution of disease outcomes remained approximately the same. A year later, the results of treatment were analyzed in 195 patients: a good outcome was noted in 62 (32%) patients, a satisfactory outcome in 117 (60%) patients, and an unsatisfactory outcome in 16 (8%) patients. Positive results remained in 92% of patients, although the proportion of good ratings decreased and the proportion of satisfactory ratings increased. After 1.5 years, we observed 180 patients, in 143 of them the pain resumed with almost the same intensity.

According to the pain assessment scale, it was established that before the operation, the intensity of pain was 47.1 ± 6.9 points, after 3 days 11.4 ± 3.5 points, after a month 6.9 ± 4.1 points, after 6 months 7.7 ± 3.8 points, after a year - 8.5 ± 4.3 points, after 1.5 years 37.7 ± 3.3 points. Apparently, there was reinnervation of the vertebral segments, and in these terms, a repetition of radiofrequency destruction is possible. Repeated manipulation was performed in 47 patients with a pronounced positive effect.

In turn, in the control group before conservative therapy, the intensity of pain was 46.3 ± 5.3 points, after the end of treatment it was 21.7 ± 4.2 points, after 6 months 39.5 ± 3.2 points, after a year 45.4 ± 5.6 points.

Thus, it is obvious that not only the higher efficiency of RFD compared to conservative therapy, but also a longer period of remission after the procedure.

A study of the biomechanics of the cervical and lumbar spine before and a month after the operation showed that the amplitude and speed of movements in the vertebral segments significantly increased.

The maximum level of flexion in the lumbar spine increased by an average of 33 degrees (from 25 ± 3.4 degrees to 58 ± 5.1 degrees ($p < 0.05$)), the maximum level of extension increased by an average of 18 degrees (from 7 ± 2.6 degrees to 25 ± 4.2 degrees ($p < 0.05$)), the speed of flexion-extensor movements increased by an average of 62 degrees per second (from 33 ± 1.8 degrees per second to 95 ± 4.7 degrees per second ($p< 0.05$)), the amplitude of lateral torso inclinations increased on average by 41 degrees (from 32 ± 1.6 degrees to 73 ± 3.2 degrees ($p < 0.05$)).

The maximum level of flexion in the cervical spine increased by an average of 34 degrees (from 31 ± 2.5 degrees to 65 ± 3.3 degrees ($p < 0.05$)), the maximum level of extension increased by an average of 37 degrees (from 22 ± 4.2 degrees to 59 ± 1.8 degrees ($p < 0.05$)), the speed of flexion-extensor movements increased by an average of 70 degrees per second (from 59 ± 3.7 degrees per second to 129 ± 1.7 degrees per second ($p < 0.05$)), the amplitude of the lateral head tilts increased by an average of 46 degrees (from 41 ± 2.2 degrees to 87 ± 3.5 degrees ($p < 0.05$)).

Improving the kinematics of the spine by eliminating the pain syndrome in the absence of an operation effect directly on the joints, slows down the process of degeneration of the joint capsule, ligaments, and intervertebral discs.

Conclusion. Our experience shows that the method of radiofrequency destruction of facet nerves is highly effective and safe. This is also confirmed by the materials of numerous “pain clinics”, in which this method is the main one in the treatment of chronic vertebrogenic pain. The main advantages of radiofrequency denervation are: controlled size of destruction; control of thermal effects due to constant monitoring of heating and electrical resistance of tissues at the end of the needle; confirmation of the correct location of the needle by electrical stimulation; carrying out manipulations under local anesthesia on an outpatient basis; short recovery period after denervation; low complication rate; the possibility of re-destruction.

Radiofrequency denervation can be considered as a palliative treatment, but the persistence of its effect, the possibility of repeated operations, makes it attractive for both doctors and patients. This method is effective in the treatment of vertebrogenic pain localized in one dermatome, when the latter is not amenable to conservative treatment. RFD is a very attractive addition to complex conservative therapy, which improves disease outcomes and prolongs the duration of the effect. Any “radical” operation implies a long-term surgical intervention, fixation of the vertebral segments (i.e., a violation of the biomechanics of the spine), the possibility of intra- and postoperative complications, and a high cost of treatment. Radiofrequency destruction compares favorably with all known non-invasive methods by its high efficiency, and from invasive ones by captivating safety.

Undoubtedly, radiofrequency denervation of vertebral segments in the treatment of vertebrogenic pain syndrome has a great future and requires additional research to determine the most productive combination with other methods of conservative treatment..

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