Is permanent neurodistruction necessary for lumbar facet joint rhizotomy?: 2-years results with percutaneous cryodenervation
C Birkenmeier

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Abstract

Background: Lumbar facet joint overloading is a central component of degenerative lumbar spine disease and in many cases is the predominant source of low back pain. The majority of trials have employed standard radiofrequency (RF) denervation for lumbar facet rhizotomy, a technique that generates a permanent colliquation necrosis of the medial branch. This leads to a permanent interruption of the facet joint sensory nerve supply as well as of the motor fibers supplying the multifidus and interspinalis muscles. In addition to the desired pain relief, this may also incur unwanted adverse effects such as the generation of Charcot joints and neurogenic atrophy of important paraspinal muscles. Interestingly, there exists no evidence in the literature to suggest that permanent neurodestruction is even required for adequate treatment success. In contrast to RF, cryodenervation has been shown to allow for nerve regeneration because it leaves important basal membrane structures intact. The few published trials on cryodenervation have shown results comparable to those of RF denervation. Work of other investigators has shown that temperatures of -20 degrees centigrade and below are sufficient to generate a prolonged nerve conduction block.

Study Objective: To determine whether percutaneous cryodenervation can adequately ameliorate low back pain originating from lumbar facet joints. Based on a 2-years follow-up we thought to examine whether permanent neurodestruction is in fact required in order to achieve adequate pain relief. In separate laboratory experiments, we wanted to measure whether the cryoprobes used for the clinical trial generate temperatures compatible with prolonged conduction blocks and with nerve regeneration.

Material & Methods: Clinical Trial: Our target criteria were low back pain (VAS 0 - 10), limitation in daily activities and general acceptance of the treatment method. Inclusion criteria: Deep-seated non-sciatic low back pain, failure of conservative measures, positive diagnostic medial branch blocks. Exclusion criteria: Previous spinal surgery with the exception of nucleotomies, relevant spinal stenosis, activated osteochondrosis, radicular pain. Diagnostic blocks were performed under fluoroscopy; improvement in low back pain of more than 50% for more than 3 hours was considered a positive block. Cryodenervation was performed also under fluoroscopy at a separate appointment. 57 patients (average age 55) were entered into the study. Follow-up was 2 years. 3 Patients were lost to follow-up and 2 others had to be excluded, so that 52 patients were available for evaluation at the end point.

Laboratory Experiment: A testing setup was devised that allowed for the measurement of temperatures at the surface of and in 1, 2 and 3 mm distance from the tip and from the side of a cryoprobe. Warming by convection was avoided by the use of a special transparent gel, adjusted to a temperature of 37 degrees centigrade. Temperatures were measured by thermoelements and data was recorded at 1-second intervals directly into a computer file. The test cycles that were run exactly simulated the conditions of clinical use. As a limitation of this setup, blood circulation in the tissues surrounding the freezing zone as well as different temperature conduction and temperature storage capacity of various tissues (e.g.: bone, muscle, nerve) cannot be simulated.

Results: Clinical Trial: 2 weeks after treatment, 65 % of patients reported significant improvement, 35 % reported little or no change in pain. The average VAS of the complete study group including failures dropped from 7.6 preoperatively to 3.5 at two weeks and to 3.3 at three, 3.2 at six, 4.1 at twelve, 3.9 at eighteen and 4.0 at twenty-four months, respectively (p < 0.05).
Limitation in daily activities improved parallel to the reduction in low back pain and 35 out of 53 patients would have the procedure performed again while 4 remained undecided. Laboratory Experiment: Temperatures at 0, 1 and 2 mm distance from the tip of the cryoprobe reached minima -10.0 and 11 degrees centigrade whereas perpendicular to the probe, -29.5, -17.5, -11 and -7 degrees centigrade where reached at 0, 1, 2 and 3 mm, respectively.

Conclusion: The temperatures generated by the cryoprobes in our experiments are sufficient to achieve a prolonged but reversible nerve conduction block. Percutaneous medial branch cryodenervation is a safe and effective treatment for lumbar facet joint pain. Our results do not suggest an inferior effectiveness when compared to the published results with standard RF denervation. Clearly, there is still insufficient knowledge about the scientific basis of well-established therapies such as RF rhizotomy. The fact that they are so-called minimally invasive therapies does not automatically guarantee that they cannot cause unnecessary damage. In consequence, the question whether the use of permanently neurodestructive techniques is even warranted for the treatment of lumbar facet joint pain needs to be discussed and the underlying factors need to be better studied.

References
Author Information

C. Birkenmeier, Dr. Med.
Department of Orthopaedics, Großhadern Medical Center, University of Munich