

**REVIEW**

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**About:** Scientific work of Dr. Petko Ganev, on the topic: "Therapeutic possibilities of cryoablation in low back pain." for acquiring the educational and scientific degree "DOCTOR".

At a meeting of the Academic Council of MU-Plovdiv with a decision of the Rector of MU-Plovdiv, I was elected a member of the Scientific Jury under the procedure for defense of dissertation for the educational and scientific degree "Doctor" with candidate Dr. Petko Ganev, from the Department of Orthopedics and Traumatology at the Medical Faculty of MU-Plovdiv.

At its first absentee meeting, coordinated by the Head of the Department, the Scientific Jury appointed me as a reviewer of the dissertation of Dr. Ganev.

The dissertation of Dr. Petko Ganev is dedicated to a widespread issue that is still developing, both among physicians from other specialties and orthopedic traumatologists. Advances in technology and the introduction of new cutting-edge surgical techniques, along with increased intensity of life and increased demands on its quality determine the current trends related to degenerative diseases of the lumbar spine and pain in it: high mini-invasiveness in therapeutic procedures, good pain response in the respective area, high levels of postoperative physical activity in a large part of the operated. Along with the obvious successes of spinal surgery, it continues to be associated with a number of complications that compromise the prognosis: aseptic or septic loosening of implants (pedicular screws, dynamic implants, etc.) in stabilization of the spine, persistent postoperative pain despite depression. neighboring segments, etc., which requires in many cases to look for alternative methods of treatment, especially when the outcome of the operation in the long run is not clear. A number of experimental and clinical-statistical studies on the subject have been published in the world literature. There are defended dissertations on pain in the lumbar spine, but there is still no comprehensive in-depth study based on cryoablation, based on our own experience and covering the development of the problem concerning this difficult issue over the years to the present day. The paper summarizes the long-term work of Dr. Petko Ganev in this difficult but innovative and challenging surgery.

The paper presented to me for review is 138 standard typewritten pages, of which 18 pages are the bibliography, and the remaining 120 pages are devoted to the introduction, etiology, research and treatment methods, purpose, tasks and

design of the study, own clinical material, the research methods, the results, the discussion and the conclusions drawn from them.

The scientific work is constructed according to the structure adopted for dissertations. The work includes 72 figures and 19 tables.

For greater clarity, a short content by pages is included at the very beginning of the dissertation.

The work begins with an introduction with historical data which contains a brief retrospective of cryotherapy over the years, as well as the importance of pathology worldwide. The dissertation continues with Anatomy and biomechanics of the lumbar spine, which emphasizes this important moment in the art of our specialty. The Etiology of Low Back Pain, Research Methods and Treatment Methods are also affected, which analyzes the various strategies in the treatment of this type of pathology.

Immediately after that, the aim of the study was presented: To study the possibilities of the cryoablation method in the treatment of low lumbar pain and its maximum rationalization.

To achieve this goal, the author sets himself four tasks, which he methodically, thoroughly and consistently performs in the course of the survey.

The tasks are properly selected and their implementation is not only a scientific but also an important clinical and applied contribution to the development of Bulgarian spinal surgery.

## **Chapter 2 Anatomy and biomechanics of the lumbar spine**

The surgical anatomy of the lumbar spine is considered, paying special attention to the individual aspects: bone anatomy, ligament complex, active stabilizing complex, as well as the vulnerable structures in the area (vessels, nerve structures). The boundaries of the lumbar vertebral canal, the nerve roots and their branches are delimited and clearly defined anatomically. Emphasis is placed on the wide range of motions that take place in this area. Special emphasis is placed on the exact anatomical position of the medial branch of the ramus dorsalis, which participates in the sensory innervation of the respective intervertebral joint. Some modern methods for pain therapy, such as radiofrequency ablation and cryoablation, are based on the denervation of the medial branch.

The columnar systems for the stability of the spine are presented with understanding, as well as that of Francis Denis from 1983 for the three-column system in sagittal plan of the lumbar vertebrae. The role of static and dynamic stabilizers related to the stability of the lumbar spine is defined.

### **Глава 3 Етиология на ниската поясна болка.**

It makes a good impression that Dr. Ganev started with the anatomical variations that can lead to "stenosis", after which he began to list the more common and significant conditions that lead to pain in the area, such as spondylolisthesis, spondylarthrosis, spondylosis, etc., which create major cases in this treatment.

The pathomorphological cascade starting with dehydration of the disc and the loss of disc height ending with the development of segmental instability is presented in detail. The pathodynamics of the development of degenerative spondylolisthesis is also presented in detail, emphasizing the fact that although there are many theories, the root cause of its occurrence still remains unclear. Less common and atypical cases that lead to or may give the impression of low lumbar pain are listed, such as:

- Prostatitis
- Inflammatory diseases of the pelvis
- Kidney stones
- Abdominal aortic aneurysm
- Gastrointestinal diseases and others

#### **Chapter 4 includes research methods.**

In this chapter he pays tribute to Dr. Ganev that he has systematized the diagnostics in the field by starting with physical methods. Indeed, with the advancement of technology, imaging is standard in solving the cause, but it is part of the art for the doctor to apply knowledge and skills to guide himself properly. Attention has been paid to how the examination can begin as soon as the patient enters, observing his gait. It has been shown how modern treatments can lead to changes in the spine, such as hip replacement. Various tests to prove root or spinal cord compression have been inserted and explained. It is also important that the dermatome distribution of the nerve roots is explained, which can easily determine the exact level of compression.

Imaging studies are also mentioned: radiography, MRI, CT, and the relatively new double-energy CT is of interest, which detects various crystal deposits in this case in the area of the spine. The scintigraphy method is used in cases due to neoplasms.

Also explained and less common, but no less informative: ultrasound and endoscopy of the spine, the latter of which is also a relatively new direction in spinal surgery, slowly gaining popularity.

#### **Chapter 5 methods of treatment**

In this chapter, Dr. Ganev reviews the existing areas and methods in the treatment of low back pain. Attention is paid to conservative and invasive treatment techniques.

He considered physiotherapy as a conservative tool with a variety of thermal procedures, ultrasound, electrical stimulation and various muscle relaxation techniques. Attention has been paid to how psychosocial factors affect pain susceptibility. Significance has also been given to the types of gymnastics that have been developing for years and aim to improve the condition, such as the methods of McKenzie and Pilates.

The groups of drugs are also listed, according to their strength and order of application:

- NSPVS
- Muscle relaxants
- Opioid analgesics
- Antidepressants

In the final part of this chapter the invasive methods of treatment are also considered:

1. Chemical ablation
2. High-temperature ablation
  - radiofrequency
  - microwave
  - laser
  - ultrasonic
3. Low-temperature, which is cryoablation, the object of this work.

In this chapter Dr. Ganev has explained the essence of this method, as well as the action of the device used and the cryoprobes themselves. He mentioned the degrees of nerve damage according to the Sedon and Sunderland classifications and explained the extent to which cryodeneration damages nerves.

The methods used for the correct performance of the procedure are also considered. The various X-ray exposures on which the procedure can be performed are mentioned. It is clearly explained how the probe is positioned at different exposures of the spine, even in cases of preserved or degenerative one. Explanations are also given for alternative methods such as ultrasound and electrostimulation guidance of the probe.

**Chapter 6 contains a brief and clearly stated purpose of the dissertation**

**Chapter 7 presents the tasks of the study.**

In this part Dr. Ganev clearly and precisely formulated the tasks of the study:

1. To monitor a sufficient number of patients who have undergone cryoablation of the facet joints for a period of at least 12 months and to determine the duration of the procedure.
2. To assess the change in quality of life before and after the procedure.
3. To apply the procedure in combination with separate surgical methods of treatment of the lumbar spine.
4. To determine the optimal method by which to perform cryoablation, in terms of positioning and duration.

In this chapter the classifications with which to report the results are specified, as the main directions are influencing the pain and change in the quality of life. The VAS (Visual Analog Scale) classification was used to assess the effect of pain on the procedure.

The modified Oswestry Disability Index (ODI) and the SF-36 system were used to assess quality of life. The questions, their nature and the way of evaluating these two classifications are also explained.

## **Chapter 8 material and methods**

The material is large enough and includes 218 patients with a diagnosis of Low Back Pain due to various reasons, treated surgically in the clinic of orthopedics and traumatology of the University Hospital in Plovdiv for the period May 2016 - February 2020.

For the performance of tasks 1 and 2, Dr. Ganev distributed the patients on the basis of the presence or absence of symptoms from the compression of nerve structures, which achieves better objectivity.

To perform task 2, balloon kyphoplasty was combined with cryoablation. The presented intraoperative color photos are of very good quality and clearly present the essence of the operative technique.

The number of clinical groups of patients is large enough and has allowed the author to make a detailed statistical processing of the results. In processing the data, Dr. Ganev, as already mentioned, referred to generally accepted tools such as the visual analog scale for pain and the Oswestry Disability Index to assess the subjective inability of patients in combination with the SF-36 system.

The analysis of the obtained results allowed the author to make a discussion and propose an approach for the most efficient and rational performance of the procedure. For greater clarity, the algorithm proposed by the author is presented in both tabular and graphical form..

Based on the sufficiently large number of patients included in the study (218 in total) and their 4-year follow-up, Dr. Ganev draws 9 scientifically sound and clinically verified conclusions. Given the practical significance of the dissertation, I believe that it is not necessary to merge or change the conclusions in order to better illustrate the presentation.

The contributions in the dissertation work of Dr. Ganev are 5 in total, and with special weight, both in scientific and practical terms is contribution number 5, concerning the introduction for the first time in Bulgaria of the method of cryoablation of the facet joints.

Dr. Petko Ganev presents 5 publications on the topic, 1 of which is in the American online journal Clinical Case Reports. The even distribution of publications on the topic over the years is impressive, as the first scientific reports are in 2016.

The work is written in perfect Bulgarian with a good balance between literary style and scientific terminology. In the presented scientific work of Dr. Ganev I can point out the following more important contributions:

1. The scientific work of Dr. Petko Ganev, on the topic: "Therapeutic possibilities of cryoablation in low lumbar pain" is the first dissertation on the topic.
2. An innovative method for improving the results (in subjective terms) in the treatment of osteoporotic fractures with balloon kyphoplasty has been developed and introduced.
3. For the first time in our country an in-depth comparative study of different therapeutic methods for the treatment of low back pain is being conducted.
4. A rational algorithm has been developed for more efficient denervation of the medial branch of Ramus dorsalis by the cryoablation method.
5. The cryoablation method of facet joints was introduced for the first time in Bulgaria.

#### **Practical significance:**

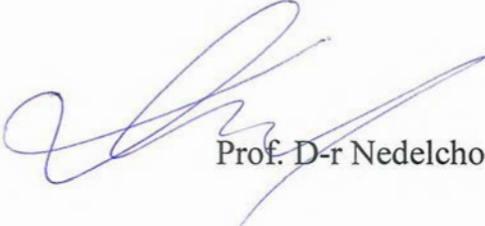
The analysis of certain factors creates an opportunity for a good response in patients with low lumbar pain in the lumbar spine with different genesis. Guidelines for the selection of the optimal method of performing the procedure are included, including in the combination with the balloon kyphoplasty.

#### **Conclusion:**

The work presented by Dr. Petko Ganev on the topic: "Therapeutic possibilities of cryoablation in low back pain" for obtaining the educational and scientific degree "Doctor" methodically traces the possibilities for lumbar therapy and the potential for improving the quality of life of the patient. The goal and tasks are precisely formulated and consistent with the nature of the problem. The clinical material is sufficient in volume, logically systematized and objectively presented. The statistical methods used provide a correct analysis of the data and allow for reliable scientific conclusions. The conclusions made have real theoretical and practical value. The critical notes are mainly of a technical nature

and do not reduce the qualities of the dissertation. The presented scientific papers in connection with the dissertation are sufficient in number and corresponding in quality to this type of scientific development.

All the above gives me reason to conclude that the work meets the requirements of the Law on Development of the Academic Staff of the Republic of Bulgaria, the Regulations for its implementation and the relevant Regulations of the higher education institution for obtaining the educational and scientific degree: "DOCTOR" and I offer to the respected scientific jury to award it to Dr. Petko Ganev.

A handwritten signature in blue ink, appearing to read 'Nedelcho Cachev', is written over a light blue rectangular background.

Prof. D-r Nedelcho Cachev MD.