REVIEW

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

At a meeting of the Academic Council of MU-Povdiv, I was elected by the Rector of MU-Plovdiv as a member of the Scientific Jury under the procedure for defense of dissertation for obtaining the educational and scientific degree "Doctor" with candidate Dr. Petko Ivanov Ganev, from 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.

Brief biographical data:

Dr. Petko Ivanov Ganev was born in 1987 in the town of Kazanlak, where he graduated from the Nikola Obreshkov High School of Natural Sciences and Mathematics in 2006. From 2006 to 2012 he studied medicine at the Medical University of Plovdiv. - coordinator in the clinic of Orthopedics and Traumatology at the end of 2012. After a competition in 2013 he was appointed as a specialist in the University Clinic of Orthopedics and Traumatology at the University Hospital in Plovdiv, where he is a specialist until now. In 2020, after a competition, he was appointed as an assistant at the Department of Orthopedics and Traumatology at the Medical University of Plovdiv. He enrolled in a free doctoral dissertation on "Therapeutic possibilities of cryoablation in low lumbar pain" in the same department from 2020. Dr. Ganev's research interests are mainly, but not only in the field of spinal and tumor surgery - he regularly participates in training courses and congresses in Bulgaria.

The dissertation of Dr. Petko Ganev is dedicated to a strongly represented and significant issue, which has yet to be developed and imposed among Bulgarian orthopedists-traumatologists. Advances in technology and the introduction of new advanced surgical techniques,

along with increased intensity of life and increased demands on its quality determine the current trends in the treatment of low back pain: creating effective methods for treating the condition, improving minimally invasive, improving quality of life and physical activity in as many operated as possible. Along with the obvious successes of spinal surgery, it continues to be associated with a number of complications that compromise the prognosis, be it septic or aseptic loosening of the car or allografts in severe trauma, prolonged pain, secondary spinal cord or root compression, degeneration segments, etc. A number of experimental and clinical-statistical studies on the subject have been published in the world literature. Cryoablation of facet joints is a relatively new method in the treatment of low lumbar pain and therefore defended dissertations on the topic are still few, so there is no comprehensive in-depth study based on personal experience and covering the development of the problem of lumbar spine pain. over the years to the present day. The paper summarizes the long-term work of Dr. Petko Ganev in this delicate, risky and challenging surgery.

The work submitted to me for review was completely revised in accordance with the recommendations made to the doctoral student during his enrollment in the doctoral program. The dissertation has a volume of 138 standard typewritten pages, of which 18 pages are the bibliography, and the remaining 120 pages are devoted to the literature review, purpose, tasks and design of the study, own clinical material, research methods and analysis parameters, results, discussion and the resulting conclusions.

The scientific work is constructed according to the structure adopted for dissertations

The work begins with an Introduction which emphasizes the importance and prevalence of low lumbar pain in people of working and retirement age and after that Chapter 1 contains historical data in which the doctoral student examines the stages of cryotherapy in world history.

Chapter 2 contains data from the Anatomy and Biomechanics of the Lumbar Spine

This part of the work is examined in detail and in depth. The structure of the vertebrae, the strengthening structures of passive and active type are examined successively, including an in-depth examination of the ligament apparatus and muscles. A large part is devoted to the description of nerve structures (spinal cord, roots), as well as main vessels and even to the level of microcirculation. The anatomy of the

nerve roots is considered, incl. and their orientation relative to the spine at the individual levels. The anatomy of the medial branch of Ramus dorsalis, which is the main object of cryoablation, is also well explained. The biomechanics in the spine is described in detail with an emphasis on the high workload of the lumbar region.
The columnar systems for the stability of the spine are also explained.

Chapter 3 presents the etiology of lumbar pain.

Immediately after anatomy, the doctoral student pays attention to the anatomical variants with their classification drawn by him, thus emphasizing the possibility of the idiopathic appearance of low back pain. After this presentation, the various conditions leading to low back pain are listed and clearly presented, starting with the most common degenerative diseases, timely presenting and classifications to them. Switches to rarer cases. He presented in detail the process of degenerative changes of the intervertebral discs, and also presented in detail the development of spondylolisthesis. Conditions are also included which, although rare, can manifest with lumbar pain:
- Prostatitis
- Inflammatory diseases of the pelvis
- Kidney stones
- Abdominal aortic aneurysm
- Gastrointestinal diseases and others

Chapter 4 presents the research methods.

Nowadays, young doctors often forget about the physical examination and rely mainly on imaging, but in the spirit of the true art of medicine, Dr. Ganev began the presentation in this chapter, focusing first on the patient's correct gait and how it can be compromised in pathological conditions of the spine. Methods have been described for proving root compression, which is in addition to the distribution of dermatomes on the lower extremities. Reference is also made to the standards of today's surgery, namely how conditions after hip replacement can affect the lumbar spine.
Of course, the standard methods of examination with radiographs, MRI, CT are also described, and in the paper it is not forgotten to insert for double energy CT, to prove deposits in different places of the skeleton.

Scintigraphy for suspected tumors has not been missed, and a relatively new but popular method of spinal endoscopy has been added.

Chapter 5 methods of treatment.

Again, instead of proceeding directly to the technique concerning this work, Dr. Ganev first made an analysis of the existing therapeutic methods. He began by describing conservative methods, which include physiotherapy techniques of electrical stimulation, ultrasound therapies, heat treatments, muscle relaxations, etc.
He also paid attention to the existing, albeit often in experimental form, therapeutic exercise using the techniques of McKenzie and Pilates.
He described, albeit superficially, the groups of drugs used in the treatment of low back pain, and in the final part he considered the invasive methods of denervation of Ramus dorsalis, including cryoablation..

Chapter 6 briefly and clearly contains the purpose of the scientific work:

To study the possibilities of the cryoablation method in the treatment of low lumbar pain and its maximum rationalization.

Chapter 7 contains the tasks of the study

The tasks that Dr. Ganev has clearly and precisely formulated for the purpose of the study are as follows:
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 the same chapter he specified the classifications with which to report the results, 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 Discusses materials 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.
To perform tasks 1 and 2, Dr. Ganev distributed the patients according to the presence of root compression.
To perform task 2, balloon kyphoplasty was combined with cryoablation.
The presented color intraoperative photos are clear and of good quality, made intraoperatively.
The number of clinical groups of patients is sufficient in volume and has given the author the opportunity to make a detailed statistical processing of the results. In processing the data, Dr. Ganev used standard tools such as the visual analog pain scale and the Oswestry disability index to assess patients' subjective disability as well as the SF-36 quality of life questionnaire.
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 the conclusions do not need to be changed in order to better illustrate the presentation.

Dr. Petko Ganev presents 5 publications on the topic, of which 4 are in Cyrillic and 1 in Latin.

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 treatment of patients with osteoporotic fractures has been developed and introduced, which combines balloon kyphoplasty with cryoablation.
3. For the first time in our country an in-depth comparative study of the results in the change of the quality of life before and after cryoablation of the medial branch of Ramus dorsalis is 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 performed in the therapy of various spinal pathology, although with similar symptoms, allows predicting the effectiveness of the cryoablation method.

An optimal method for performing the procedure has been determined, combining mini-invasiveness, minimum duration and effect.

The work presented to me for review is well made and hardly gives grounds for criticism. Dr. Ganev complied with the critical remarks made to the extent that he drew a large number of the used figures.

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" traces the development of methods of treatment of low back pain. 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 with 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 a large doctorate.

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.

Prof. Dr. Luben Stokov MD