

Review

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For dissertation work of Dr.Biliana Petkova Kamenova, Ph D of individual training at Clinic of
Hepatobiliary, Pancreatic and General Surgery to „Adcibadem City Clinic Tokuda Hospital”
Sofia.

Subject:

Dissertation work: „Anesthesia and intraoperative neurophysiological monitoring for surgical
correction of childhood scoliosis” for the award of educational and scientific degree „Ph.D”.

The dissertation work is referred to public defence by scientific collegium to „ Adcibadem
City Clinic Tokuda” Hospital.

Surgical correction of scoliosis in childhood affects a contingent of patients, which is diverse
in etiology and severity of the degree of deformity. The challenges for the anaesthesiologist
are complex. The use of intraoperative neurophysiological monitoring (IONM) is currently
considered the “gold standard” for surgical correction of scoliotic defects, but interest in this
monitoring is relatively recent worldwide. In this sense, the topic covered by the dissertation
is relevant and significant in scientific and practical terms.

Intraoperative neurophysiological monitoring is important for the assessment of spinal cord
function, providing greater safety for the patient regarding the risk of postoperative
neurological deficit. The combined use of different techniques of intraoperative
neurophysiological monitoring is associated with greater sensitivity and reliability of
monitoring. Good knowledge of the interaction between IONM and anesthesia allows to
choose an anesthesia protocol in order to optimize the signals from the monitoring.

Significant changes in responses may indicate neurological impairment, both as a result of
surgery and abnormalities in physiological parameters or suboptimal positioning of the
patient. Good collaboration and timely response of the team in case of significant changes in
performance are the key to preventing the occurrence of irreversible neurological deficits.

The dissertation is well structured, and its structure is in accordance with the requirements
for the preparation of scientific work for obtaining a scientific and educational degree
"Doctor". It is written on 133 standard pages, including 59 tables and 18 figures. The
bibliographic reference contains 180 literary sources, of which 2 in Bulgarian and 178 in
Latin. Includes the following separate parts: introduction - 2 pages; literature review - 34
pages; purpose and tasks - 1 page; staging, materials and methods - 7 pages; results - 47
pages; discussion - 14 pages; protocols - 7 pages; conclusions and recommendations - 2
pages; contributions - 1 page; bibliographic reference - 13 pages; publications related to the
dissertation - 1 page; application - 3 pages.

The literature review is clearly and competently presented, covering all aspects of the
research topic. The essential aspects of the preoperative assessment of patients are

considered - classification of scoliosis depending on the etiology, the specific accompanying pathology of the respiratory, cardiovascular system and preoperative neurological deficit. The components and technical performance of multimodal neurophysiological monitoring in the context of scoliotic surgery are described in detail - somatosensory evoked potentials (SSEP), transcranial motor evoked potentials (TCMEP), electromyography (EMG), electroencephalography (EEG). The specificity of the patient's positioning, the influence of anesthetics and physiological parameters - hypotension, anemia, hypothermia, hypoxemia on IONM, as well as approaches to compensate the blood loss are presented. All these aspects form the foundation of scientific development.

The aim of the dissertation is "By analyzing the data from intraoperative neurophysiological monitoring to develop protocols for anesthesiological behavior in surgical corrections of scoliosis in childhood, in order to minimize the risk of neurological and other complications." To achieve this goal, 6 tasks are set, which are presented clearly and correctly formulated, according to the issues presented in the literature review.

The study was prospective, conducted over a period of 10 years, and included 135 patients from 3 to 18 years of age who underwent surgical correction of scoliosis, with different scoliotic etiology. Patients were divided into two groups according to the chosen anesthesia protocol - with combined inhalation and venous anesthesia ($MAC \leq 0.5\%$) (99 patients) and total intravenous anesthesia (36 patients). Regarding the applied multimodal IONM, the used modalities, the location of the stimulation electrodes, the technical parameters of stimulation, the locations for signal reading and the accepted definitions for significant change of the response are described. The following were monitored: in the preoperative period - anthropometric data, type of jumping, Cobb's angle, Pulmonary function test, ABG's, chest radiography, ECG, EchoCG, preoperative neurological status, laboratory parameters; in the intraoperative period - standard anesthesiological monitoring, temperature, diuresis, anesthetic doses, blood loss, infusion therapy, including chemo- and autochemotransfusion, catecholamine maintenance, parameters affecting the surgical intervention (operative access, duration of the operation, number of corrections; IONM components: registration of baseline responses, dynamic monitoring of SSEP, TCMEP, EMG, EEG and registration of significant changes in signals, stage of occurrence of changes, reversibility of changes; in the postoperative period - complications, postoperative analgesia. The topic has been developed comprehensively and analyzed: the anesthesiological approach in order to maintain optimal hemodynamic and physiological parameters, as well as in view of the successful registration of SSEP and TCMEP responses, and recording changes in signals; the influence of the etiology of scoliosis, the preoperative angle of scoliotic curvature and the number of levels of surgical correction on intraoperative blood loss, on the need to include catecholamines and on postoperative complications. A statistically significant relationship was found between the preoperative Cobb's angle, the type of scoliosis and the number of levels of surgery and blood loss, on the one hand, and the intraoperative infusion of catecholamines, on the other. Neuromuscular scoliosis is associated with a higher risk of postoperative respiratory complications. A relationship was found between neuromuscular scoliosis and lower success rates in recording SSEP and TCMEP baselines. It was found that the type of anesthetic protocol does not affect the occurrence of a problem in the registration of SSEP and MEP, and the registration of changes in evoked potentials, specifying that the current required to obtain TCMEP in combined anesthesia should be increased two times more than TIVA. Changes in intraoperative SSEPs

were registered in 31.9% of patients, and in TCMEP - in 17.8% of patients. The change in physiological parameters was the reason for significant changes in SSEP in 18.6% and in TCMEP in 16.7% of all registered changes. About half of the irreversible changes had postoperative neurological involvement, and all postoperative neurological complications resolved within 6 months. Specificity and sensitivity of the applied multimodal IONM were calculated to be 93% and 90%, respectively. A protocol for anesthesia and intraoperative neurophysiological monitoring in surgical corrections of scoliosis, a checklist for electrophysiological changes, as well as an algorithm in case of appearance of electrophysiological changes have been prepared.

The conclusions and recommendations are 16. They are systematised and in accordance with the collected and analysed data.

I have no critical remarks.

Three publications in scientific journals related to the dissertation are presented.

In conclusion, I believe that the dissertation of Dr. Biliana Petkova Kamenova has all the necessary qualities for the award of educational and scientific degree "Ph. D" and I recommend the members of the scientific jury to vote positively.

Prof. Silvi Georgiev, MD, PhD