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About Modern Requirements to Higher and Postgraduate Education Ophthalmologists

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Introduction

Modern ophthalmology is actually a branch of applied physics. However, it is difficult for many ophthalmologists to use the new modern high-tech diagnostic and therapeutic ophthalmological equipment correctly and in full. There are probably three objective reasons for that.

Reason 1

This objective reason is the most important and applies to the entire medical community: doctors today are sorely lacking knowledge "at the junction" in the field of fundamental disciplines-primarily physics, mechanics, hydraulics and theory of management. For ex-ample, modern high-tech diagnostic or clinical equipment requires serious knowledge in the field of applied physics, but in many countries the mandatory entrance examination in physics to medical higher education institutions is not carried out, and the number of hours allocated to the study during the training of the fundamental laws of nature (physics and biomechanics) is extremely reduced. But new technologies always require adequate specialists. Therefore, we now have the most modern diagnostic and clinical equipment, but in order to fully work on it, we, in some cases, do not have highly trained qualified personnel.

For example, in 2002, according to the requirements of one of the programs, in the first year of medical University for 279 hours subjects such as physics, biophysics, medical equipment, elements of higher mathematics and probability theory, the basics of mathematical statistics are being studied. We quote: "This lecture course includes sections that lay the Foundation of theoretical knowledge necessary for understanding the processes of life, self-organization of living sys-tems, the processes of their evolution and interaction with the environment, the issues of modeling complex nonlinear systems on the examples of environmental models, pharmacokinetic models, models of immune processes, etc".

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It is assumed that it is possible to teach a student to think systematically and give deep knowledge in just two months (cite): "on the basics of almost all modern methods of functional diagnosis, such as electrography, computer tomography, magnetic resonance spectroscopy and others, as well as a number of treatments in electro -, magnetic and laser therapy, etc". This "clip like knowledge of the fundamentals" will not give confidence to the future doctor in his clinical activity, which can often be seen in practice today, especially when some of our doctors are trying to con-firm their medical diploma in a standard procedure abroad. It became quite obvious that the impossibility of obtaining the necessary fundamental knowledge in the higher medical school or during the cycles of postgraduate improvement of the physicians will inevitable and soon enough transfer our medicine in modern conditions to the category of a community based only on Faith and not on knowledge of the laws of nature. Lack of necessary knowledge of fundamental disciplines leads to the fact that many ophthalmological publications have serious flaws, connected both with the statement of the problem and with the interpretation of the results of research in the part of non-observance of the basic laws of mechanics, i.e. laws of nature.

And, in fact, ophthalmologists themselves are not to blame for this - they simply weren't properly taught. This extremely unfavorable situation in terms of the shift of emphasis in the educational programs of ophthalmologists that has occurred in the last decades should be urgently changed if we want them to be competitive in this area of medicine. And the innovative development of ophthalmology without taking into account the fundamental principles, apparently, is impossible. And it is good that in a number of medical schools the first necessary steps have already been taken, when physics is again included in the list of examination disciplines. In a number of countries, the departments of ophthalmology are organized on the basis of interdisciplinary universities, when the first two years the future doctors study fundamental disciplines. We already know cases of inclusion in some ophthalmological scientific research centers of specialists from other scientific specialties, in particular, physicists and mechanics. In a number of medical universities in some countries, the faculties of "Basic medicine" are organized. All of this clearly demonstrates the trend: modern ophthalmology requires a synergetic interdisciplinary approach using the experience of specialists in different fields of science. The urgent need for such an approach, in our opinion, has already been felt by many leaders of ophthalmological schools in different countries. Long-term practice of training the clinical residents in Russia has shown that doctors-graduates from state multi-profile universities with the departments of ophthalmology, who actually have a systemic University education, are significantly superior in their clinical thinking in comparison to graduates from medical universities.

In connection with the mentioned above, high popularity is noticeable among the ophthalmologists of international conferences on "Biomechanics of the eye", conducted in Russia since 1998. The concept of "Biomechanics of the eye" is almost firmly established today in the ophthalmic environment. It seems to us that the appearance of high-level ophthalmologists in the lists of reviewers and editorial boards of scientific ophthalmological journals, as well as in the staff of leading ophthalmological and research centers is not far away. That is, to give an opportunity to get an almost fast and real innovative effect and save money allocated for research, as the number of errors in the formulation of the research problem and the interpretation of the results will decrease. It is pleasant to note that the Journal of Clinical Research and Ophthalmology is probably one of the first in the world to follow this promising path and introduced this year to the editorial Board of the journal a specialist in the field of biomechanics. Such specialists are able not only to notice and eliminate errors in the formulation and interpretation of the results of experimental and clinical studies, but also to ensure their adequacy to the fundamental laws of nature. That is, to give an opportunity to get an almost fast and real innovative effect and to save money allocated for research, as the number of errors in the formulation of the research task and the interpretation of the results will decrease.

As examples of this approach, we would like to note the emergence of interdisciplinary sessions with sections including biomechanics, with the participation of experts from different fields of science at international ophthalmological congresses. In particular, a separate interdisciplinary session "Biomechanics in glaucoma" was held at the 7th world Glaucoma Congress (June 2018 Helsinki) under the chairmanship of Professor Cinthia Poberts (United States) and Professor Nick Strouchidis (United Kingdom). The 3rd Global Pediatric Ophthalmology Congress (March 2018, London) hosted a separate interdisciplinary session "Physiology and biomechanics of the eye", chaired by the first two authors of this article. The final resolution of the Congress notes that Russia today is the undisputed leader in the field of physiology and biomechanics of the eye [1]. It should be noted that over the past 10 years the relative number of ophthalmologists with a good education in the field of fundamental science who are capable of setting the task of clinical research adequately to the laws of mechanics has clearly increased. There are already examples in different

countries when doctors supplement their first higher medical education with fundamental knowledge in the field of physics and mechanics at the expense of the second higher education. That is why today the training of ophthalmologists, for example, in Germany, is carried out, including, on the basis of large technical universities, such as, for example, Munich technical University, which allows to give the doctor the necessary fundamental education in the total period of training 5-7 years. Note in this regard, the program of postgraduate education of modern ophthalmologist should have a mandatory section "Physical basis of equipment for diagnosis and treatment" (at least 35 hours), as well as a mandatory subsection "Physiology of the eye" (45 hours). The difficult conclusion to be drawn is unequivocal: the allocation of medical faculties from general education universities to independent higher medical schools in a number of countries was a systemic error, which in modern conditions must certainly be corrected. Examples when the initial engineering education in the fundamental sections of science helped to reach high heights in physiology or medicine in history is enough: G. von Helmholtz (physicist, mechanic, physiologist), Nobel laureates in the field of physiology and medicine A. Gul strand (fond of mechanics, dreamed of career of an engineer) and I.I. Mechnikov (graduated from the General Education Engineer University), physiologist I.M. Sechenov (military engineer) and others.

Reason 2

The second objective reason, which, in our opinion, does not allow us to avoid obvious mistakes in ophthalmological studies, is the absence of generally accepted ideas about the physiology of the interrelated work of intraocular systems. Up to date, there is, as far as we know, no monography or serious basic textbook on "Eye Physiology" in the world. Separate fragmentary information about the operation of the eye systems was obtained, as a rule, 50 or more years ago, not systematically reduced to a single physiological concept, and multivolume guidelines are full of contradictions and omissions. For example, even the question of parasym-pathetic or sympathetic innervation of portions of the ciliary muscle was so confusing by numerous studies that the polarity of the opinions of different authors in this fundamental question can only be characterized as a "physiological blockage" [2]. The forgoing suggests that it is necessary to direct the efforts of researchers, first of all, to the explanation of the fundamental physiological processes in the eye. Heart surgeon Christiaan Barnard (1922-2001) [3,4] for the first time in the world successfully transplanted the heart from person to person, in the last years of life stressed in numerous interviews about the need to "review all our ideas about the work of the heart." And he was absolutely right, because there was diagnostic equipment that allows you to monitor the heart in vivo. By the way, his direct teacher, to whom he twice came to the USSR, Chr. Barnard believed Vladimir Petrovich Demikhov (1916-1998) - the founder of the world's cardiosurgery and transplantology, had a magnificent fundamental education (biological faculty of Moscow State University, Russia).

For the proposed in 1954, the technology of mammary-coronaral artery bypass grafting V. P. Demikhov became the laureate of the State prize of the USSR only in 1988, when using these operations extended the life of the leaders of the country. And at the last stage of his scientific work, this outstanding engineer-biologist was especially persecuted and died in Russia in obscurity and poverty during the so-called "perestroika". In ophthalmology, in our opinion, it is necessary to do the same "by K. Barnard" and to re-vise our ideas about the work of the eye radically. In particular, we are still chained to myths about the primacy of the eyes trabecular, not uveoscleral outflow pathway of the aqueous humor (BB). We do not use in practice the basic principle of regulatory interaction of intraocular systems - the absolute priority of the accommodation control system over the outflow control system. We do not understand the main physiological purpose of the vitreous chamber and have no idea what per-centage of the total outflow of aqueous humor comes through the lens. Don't understand the functional role of the sclera in the regulation of the volume of the eye and IOP, and the percentage of aqueous humor outflow drain through the structures of the sclera in healthy state and during the disease [2,5-16]. The list is endless, but one thing is clear: without resolving a number of fundamental questions correctly to study the pathophysiology of a number of pathologies to the level of creating a generalized theory is impossible.

Reason 3

This reason follows from the first and is associated with methodological and instrumental errors of ophthalmic measurements. Not taking into account these errors - is an-other of the many reefs, which ophthalmology will have to overcome. From the whole sea of Scientific research in ophthalmology, we know no more than a dozen, which somehow take into account the measurement errors. Here is an example: the measurement errors of IOP are, according to various estimates, from 5 to 60% [17]. i.e. we must objectively record in the history of the disease is not the figure of the tonometric IOP, for example, 28.6 mm Hg. (if the patient belongs in his youth to a high zone of true IOP according

to A. P. Nesterov – 17-21 mm Hg), and it is necessary to add to the measurement the error of at least ±25%, which gives a result of 26.8±6.7 mm Hg. This result should not be confused with the spread of the data that we like to indicate in scientific articles "for persuasiveness", not realizing that with this we reduce the fact of measurement to absurd!

This metrological "arithmetic" translates the mentioned above increase of tonometric IOP in the patient in the category of discharge or high norm (26,8 - 6,7 = 20,1 mm Hg), or ocular hypertension (26,8 + 6.7 = 33.5 mm Hg), and both of these diagnoses will be objectively legiti-mate! In technology, the measurement error in the experiment should not exceed 2%, other-wise the results obtained cannot be considered trustworthy. The lack of" metrological culture "in modern medicine largely turns the so-called" evidence-based medicine", in fact, into a religion. We can write a multi-volume monograph on what and how we measure or interpret incorrectly. Today it became clear that not taking into account the measurement errors in the clinical experiment, both methodical and instrumental, not only does not allow comparing different methods of measurement, but also, often, does not allow to objectively considering the results obtained to be reliable. The first ophthalmological publications in this direction are already available: these are [17,18].

Conclusion

For effective use of highly technological ophthalmological equipment and adequate professional education of ophthalmologists it is necessary to rapidly expand the level of their basic knowledge in the field of fundamental disciplines.

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