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REVIEW

50 Years of the Czech and Slovak Society of Experimental Cardiology – Historical Background and Scientific Benefit

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Summary

The history of the Czech and Slovak experimental cardiology describes a completely unusual curve. The personality of J.E. Purkynje caused this field to reach unprecedented peak at the very beginning of its modern history. The development of experimental cardiology after the death of the great scholar was certainly not linear. Just when it seemed to be raising its head, the German occupation came. Its second hopeful awakening was delayed for a long time by forty years of isolation. The significant limitation of foreign contacts gradually led to the loss of hopefully developing contacts, to professional isolation and lagging behind the stormy development of world science. At the moment of greatest depression, in 1971, in Prague there was created a professional forum that was supposed to enable its intellectual survival and reduce the negative consequences of the "splendid isolation". The Society of Experimental Cardiology (SEC) was founded at the Czechoslovak Physiological Society of the Czechoslovak Medical Society J.E. Purkynje, with the main task of introducing theoretical and clinical cardiologists to the advances in world cardiology. The first meeting was held in 1973 and in 2023 we celebrated already the 50th anniversary of SEC. Moreover, nowadays we see the increasing interest of the young researchers, both experimental and clinical cardiologists, who consider SEC a very attractive platform for their education and professional growth.

Key words

Experimental cardiology • Czech and Slovak Society • History • Relationship to clinical cardiology

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Introduction

Modern cardiology is a scientific discipline where the close cooperation between the theoretical and clinical cardiologists has the longstanding tradition, spanning from the molecular level to the patient's bed. Any attempt to break this continuous line and artificial division into theoretical and clinical cardiology is thus a useless artifact. Today's requirements for the education of cardiologists correspond to this fact; at a high level of development of diagnostic and therapeutic tools, solid theoretical knowledge is a necessary prerequisite for successful clinical practice. Similarly, the theoretical cardiologist is influenced more than ever by new problems of clinical cardiology and his meaningful experimentation is unthinkable without their well-founded knowledge.

The point of view of the history of the scientific discipline is given on the one hand by the time interval from the described events, on the other hand by the subjective view of the author. This also fully applies to the history of the Czech and Slovak experimental cardiology. The indisputable advantage of this scientific discipline is the fact that at the beginning of its modern history stood the personality of J.E. Purkynje. It must be remembered that pre-Purkynje physiology was according to one of his founders, A.v. Haller (1708-1777) only a kind of anatomia animata (living anatomy), or rather a commentary on anatomy or pathology. It was Purkynje, who at the beginning of the 19th century, characterized by significant discoveries in the field of natural sciences, turned his attention to the newly developing physiology. He made his physiology the basis of the study of medicine, understood it as an experimental, not

speculative, science and emphasized its dynamic nature. His scientific interest in the function of the heart and blood vessels fits into this concept [1].

Purkynje's heritage

J.E. Purkynje published his greatest discovery in the field of the cardiovascular system in a thesis written to order. Two distinguished professors of the Jagellonian University in Krakow, Jozef Majer and Fryderyk Skobel, asked him in a letter dated March 21, 1839, for a contribution to the Annals of the Faculty of Medicine of the Jagellonian University [2]. In a short postscript, they made a very interesting remark that publishers prefer theoretical work than a contribution from the field of practical medicine. Shortly afterwards, Purkynje sent them a work entitled "New Observations and Investigations in the Subjects of Physiology and Microscopic Anatomy"; it was published a few months later in the above-mentioned magazine in the Polish language. In this publication, for the first time in history, we find a description of the structure, which now appears in physiology textbooks all over the world under the name of Purkynje fibers, in a few lines [3]. Six years later, Purkynje decided to describe the findings published in the Kraków publication again, but this time in the world language of the time – German – in Archiv für Anatomie, Physiologie und wissenschaftliche Medizin. Shortly afterwards (1845) the work was translated also into English and printed in the London Medical Gazette. Purkynje, however, changed his mind about the origin of the fibers in this article. While in the Kraków publication he still believed that these were cartilage fibers, in the German version he was already leaning towards the opinion that they were muscle fibers. In this context, it must be emphasized that Purkynje described his observations about special fibers in the heart very briefly, in a few paragraphs, in works that for the most part dealt with other questions – and yet it is a discovery of fundamental importance. This testifies to the fact that he was so interested in the original work in several fields at the same time that he did not even think on some systematic monography. However, his efforts to introduce his observations to the widest possible scientific community by publishing them in top journals of the time, are still relevant.

Today, almost 180 years after Purkynje's discovery, we know that Purkynje fibers are part of the so-called conduction system of the heart, which ensures the automatic rhythmic generation of the cardiac impulse and its transfer to all areas of the heart muscle. This function of Purkynje fibers was first pointed out by S. Tawara in 1906, i.e., more than half a century after Purkynje's discovery. A detailed study of the function of the conduction system was made possible only by the discovery of electrocardiography. A detailed analysis of electrical events using new, more complex methods then brought important findings that enabled effective treatment of serious heart diseases and confirmed the fundamental importance of Purkynje's discovery for clinical practice.

A masterful example of Purkynje's modern physiological thinking is his work on the suction power of the heart. He summarized his views on this interesting chapter in the physiology of blood circulation in 1843 in the lecture "Über die Saugkraft des Herzens", published a year later in Breslau. The basis of his idea is the observation that during ventricular systole, the atrioventricular orifice is pulled into the ventricle due to the contraction of the papillary muscles; this creates a conical space, turned towards the atria, into which blood flows from the vena cava. With their outer surfaces, the valves simultaneously perform another function – they drive the blood in the chambers towards the open orifice of the large arteries. It is necessary to mention one more indisputable contribution of this Purkynje's work; in fact, he expressed the wish that in the future physiologists would cooperate with physicists and mathematicians and attempt an exact definition of the relationships during systole and diastole [4].

The correctness of Purkynje's ideas was best verified by time. Today, no physiologist doubts the existence of the suction power of the heart, the so-called *vis a fronte*, which plays a significant role in venous return. What's more, if we compare Purkynje's description of this event with physiology textbooks (see e.g. Guyton), we find that it is an almost literal translation [5]. Only one fact is striking: unlike several of other, undoubtedly original observations of this great scientist, his name is not usually associated with the description of the suction power of the heart. This ingratitude of generations could mean a small tragedy for many of other, less important researchers for their scientific legacy. Fortunately, J.E. Purkynje can be proud of a whole series of original findings, which, on the contrary, without his name would be just a meaningless torso. It can only be stated that Purkynje set the bar for our experimental cardiology at the very beginning of its

modern history to such a height that it has not yet been surpassed [6,7].

First half of the 20th century

If J.E. Purkynje, this genius scholar, could be criticized for something, perhaps only that he did not take enough care of his successors, who would be able to continue the work he started in a comparable way. Thus, experimental cardiology gradually became only part of the teaching of physiology and passively accepted the knowledge obtained in world laboratories. The Czech and Slovak contribution to world knowledge in this area was suppressed for many years. Surprisingly, clinical cardiologists took care of the fact that theoretical cardiology survived its lean years. A typical example was internist Emerich Maixner, especially with his 1912 monograph "Heart and Vascular Diseases" [8]. In the preface, he emphasized: "...the clinic lived up to its task only when it proceeded to the methodical use of the experiment and the physiology inquired". And further: "...the physiology of a sick person, in close cooperation with pathological anatomy, established the biology of disease and proved that the organism in a physiological and pathological state is governed by the same laws".

However, it must be stated objectively that our physiology did not sleep at that time, only the heart and blood vessels were not its favorites. Under the leadership of Professor Mares, the Institute of Physiology of the Faculty of Medicine of Charles University in Prague produced many outstanding personalities, scientists and teachers, such as Edward Babak, Jan Belehradek, Vilem Laufberger, Antonin Hanak, and others [9]. It is interesting that, paradoxically, the later development of experimental cardiology was most influenced by the "non-cardiologist" Edward Babak [10]. According to Krecek [11] the foundation of the experimental physiology of the developing individual seems to be Babak's greatest message to future generations. Until then, studies of individual development were the domain of morphologists. Babak noticed at the very beginning of his research activity that it is primarily a matter of capturing the dynamics of the expression of innate processes in confrontation with external influences.

The situation begins to change significantly in the early 1930s. In the Institute of Physiology of the Faculty of Medicine of the Charles University, young associate professor Frantisek Karasek began to study the electrical activity of carotid depressors during changes in blood pressure using a technique he learned during his study visit at the prominent Belgian physiologist Heymans. At the same time, he dealt with Loewi's transmission of nerve impulses, for which Loewi and Dahl were later on awarded the Nobel Prize. He demonstrated that the influence of the vagus on the heart is mediated by acetylcholine and was the first to study circulatory changes in experimental atherosclerosis in rabbits [9]. In 1935, a young medical student, Otakar Poupa, came to the Institute of Physiology and Karasek commissioned him to repeat Loewi's experiments on frog hearts. Poupa thus encountered experimental cardiology for the first time and he himself says about it: "...this first attempt stigmatized me for the rest of my life" [12].

Another experimental cardiologist worked at the Institute of Physiology in Prague, the lively Vladislav Kruta, who was fully absorbed in the study of the effect of frequency and temperature on cardiac contractility. Already in 1937-1938, he published two extremely successful works in the Archives Internationales des Physiologie, which are still considered classics and are still cited. At that time, Kruta held the position of executive director of the Biological Society, which was like the French Societé de Biologie. As Poupa writes: "...from today's distance and also from despair over the super-specialization of biological sciences, the Biological Society of that time seems to me a kind of paradise that will never return". The most important representatives of biology and medicine of the time met every month: physiologists (Belehradek, Sekla), anatomists (Borovansky, Weigner), zoologists (Komarek, Wenig), and botanists (Nemec, Korinek, Krajina); internists (Prusik, Mentl, Gjuric, Charvat) and pediatrician Svejcar. The Biological Society had two publication forums. One was Biological Letters, excellently maintained, but printed in Czech, and thus inaccessible to the world. The second developed thanks to Kruta: the Biological Society became a branch of the Paris Societé de Biologie, which created the obligation to print reports of activities in French in the Comptes Rendus. And so it happened that, for example, Laufberger's discovery of ferritin has its priority from publication in this very journal [12]. The Institute of Physiology in Bratislava was established at the Faculty of Medicine in 1924. The first head became Antonin Hanak, the scholar of the Prague physiologist Frantisek Mares and collaborator of English physiologist Joseph Barcroft. In his scientific work he primarily focused on blood physiology and circulation.

The German occupation and the closing of

universities crippled the promisingly developing science and thus also experimental cardiology for a long time. Scientific work was banned, laboratories were sealed. The Institute of Physiology in Prague became depopulated. Kruta emigrated, Karasek, who at the time was dealing with hormonal influences, was invited to the Department of Gynecology and Obstetrics, Laufberger found refuge in the state health institute and, in addition to his routine work, devoted himself to theoretical questions of nervous activity, especially memory. Poupa goes to the Remed pharmaceutical factory in Prague-Karlin to titrate hormones, especially insulin and thyroid hormones. In general, it can be said that the pharmaceutical industry became a breeding ground for young Czech scientists during the war.

The end of the war meant great relief, great hope, and stimulated the work enthusiasm of young and old returnees; everyone helped to restore normal research and teaching activities. The Institute of Physiology of Charles University began to work in 1945 again under Laufberger's leadership in a new building at Prague-Albertov. The experimental cardiology battalion continued to be managed by Karasek, who dealt with issues of blood pressure regulation [9]. Laufberger himself dealt with electrophysiology and some questions of higher nervous activity in his laboratory. Poupa and his young colleagues, Krecek and Schreiber, built on their wartime experiences and became pioneers of modern experimental endocrinology. In Bratislava, the new head of the Institute of Physiology, Juraj Antal, focused on solving issues related to hemodynamics and respiration.

The short period between 1945 and 1948 was one of the best that our physiology experienced. The borders opened and the flow of information found an unusually eager ground. Physiology, including experimental cardiology, seemed to have the potential to enter the international field as an equal partner with other sciences. Unfortunately, that didn't happen.

After the events of February 1948, the situation in Czech and Slovak science changed rapidly. Its freedom and independence, as well as the possibility of free discussion, were irretrievably disappearing. Reading the Stalin-era medical biology journals is still instructive today: the editorials abound with tirades about the only correct prescriptions for research following the pattern set by official biology and medicine in the Soviet Union. The promisingly developing team of experimental cardiologists at the Institute of Physiology of the Faculty of Medicine in Prague was also affected: Kruta went to Hradec Kralove, where he clashed with the ruling elite because of his war history in the Royal Air Force. Poupa had to leave his university career, which had started promisingly, for eleven long years - with a short stop at the Department of Physiology in Brno – and his scientific activities were also significantly limited. Karasek's personality was changed by a bad illness: from an active excellent researcher he became a teacher absorbed in lectures and writing a textbook.

In the second half of the 1950s, however, the situation in experimental cardiology began to slowly improve. The excellent physiologists Laufberger, Kruta and Poupa, whose scientific cradle was precisely the Institute of Physiology of the Faculty of Medicine of the Charles University as well as Antal in Bratislava, are gathering young enthusiasts around them and building the foundations of modern Czech experimental cardiology at new workplaces. In this way, intellectual centers with basic laboratory facilities, later on called the Prague, Brno and Bratislava schools of experimental cardiology, were created [13].

The years 1950-1969; origin of centers of experimental cardiology

Prague school of experimental cardiology

In the 1950s, scientific activity in cardiology in Prague moved to the newly established Czechoslovak Academy of Sciences (CAS) and to the research institutes of the Ministry of Health (Institute for Clinical and Experimental Surgery, Institute for Blood and Circulation Diseases), which were created according to the Soviet model, because universities were supposed to be the main goal of undergraduate education [8]. In 1953, Laufberger also moved from the faculty's Department of Physiology to the then CAS and founded the Laboratory of Higher Nervous Activity (later on the Laboratory of Graphical Investigation Methods). He combined his electro-physiological research with the needs of clinical medicine and turned his attention to the electrical manifestations of the heart activity. He set himself a difficult task: to capture the spatial dynamics of the heart field. This includes his discoveries in the field of spacio-cardiography, issues of quantitative analyzes of biological phenomena (e.g. evaluation of electro-cardiographic examinations) and attempts at their mathematical processing. Laufberger's life's work is huge, covers many issues and testifies to his rich invention and constant curiosity of the analytical spirit [9,12].

In 1956, Otakar Poupa came to the Institute of Physiology of the CAS (founded in 1954) with his new team. Already during his short tenure at the Institute for Human Nutrition Research, he gathered around him excellent young adepts of science (Holeckova, Fabry, Lat, Parizek, Faltova, and others), who began to intensively deal with various aspects of the adaptation of the digestive system to a change in food. However, Poupa's scientific thinking was marked for the rest of his life by the meeting with the founder of our aviation medicine, physiologist and Air Force General Dominik Capek. At the Army Aviation Medical Institute, he studied issues related to staying in an oxygen-poor atmosphere, as required by the growing importance of jet aircraft. At that time, the first papers appeared in scientific literature showing that populations living at high altitudes had a significantly lower incidence of coronary heart disease. These epidemiological observations were a significant stimulus for several experimental cardiological laboratories to intensive study of the increased resistance of the heart muscle to acute lack of oxygen. It is particularly gratifying that the first experimental study, demonstrating that adaptation to chronic hypoxia (simulated in a barochamber), protects the heart muscle from the effects of acute oxygen deficiency, was published in Prague by Kopecký and Daum [14] and Poupa *et al.* [15].

In 1959, Otakar Poupa began lecturing again, this time pathological physiology, at the then Faculty of Pediatrics of Charles University; he was also appointed professor here in 1961. At that time, he managed to create a completely unique example of working cooperation between the Academy of Sciences and the Faculty of Pediatrics of Charles University – both in the field of scientific research and in teaching medical students. He has developed broad-based research on the phylogenetic and ontogenetic development of cardiac muscle with a special attention to the needs of clinical cardiology. This issue attracted many mostly young researchers and became the basis of the Prague School of Developmental and Adaptive Cardiology. A number of priority studies, still cited, results of the development of cardiac blood supply in ontogeny and phylogeny (Rakusan, Ostadal, Wachtlova), the cardioprotective effect of adaptation to chronic hypoxia (Korecky, Prochazka, Krofta, Souhrada), factors affecting the extent of isoproterenol-induced cardiac necrosis (Faltova, Turek, Rychterova) and the role of contractile proteins in these processes (Deyl, Pelouch) were published. The excellent cardioembryologist Rychter, co-author (with Lemez) of the first work on experimental congenital heart defects, one of the founders of Czech experimental embryology, worked closely with Poupa's group. In this context, it should be noted that even today such a modern cardioprotective phenomenon – ischemic preconditioning – has its origin here: as early as 1966, Poupa and his colleagues published a work in which they showed that repeated administration of small doses of the beta-mimetic catecholamine isoproterenol significantly reduces the extent of heart muscle damage induced by a subsequent necrogenic dose [16]. Unfortunately, the work was published in a local magazine (albeit in English) and the described effect was not given a commercially successful name. However, the ongoing interest of world authors in this forgotten publication should please Czech cardiologists.

Fortunately, Poupa was not alone with his developmental studies at the Institute of Physiology of the then Czechoslovak Academy of Sciences. Jiri Krecek and his collaborators (e.g. Hahn, Illnerova, Koldovsky) contributed to the development of the theory of critical developmental periods: Krecek's works on the consequences of early weaning for the further development of an individual are classic. Pilot studies on the ontogeny of blood pressure and the factors that influence it during development were also created in his department (Albrecht, Jelinek, later Kunes, Zicha). Czech developmental medicine, founded by Edward Babak, was not simply lost: it found its outstanding protagonists even in the post-war years [17].

Brno school of experimental cardiology

After a short stay at the Faculty of Medicine in Hradec Králové, in 1951 Vladislav Kruta became the head of the Department of Physiology at the Faculty of Medicine in Brno. Armed with his pre-war laboratory experience from Prague and Paris, the author of several excellent publications on the relationship of cardiac contractility to frequency and temperature, he found an environment in Brno, where clinical cardiology already had a long-standing tradition. It was founded in the twenties by Vanysek and continued by his students Stejfa sen. and Svoboda. Even in the Department of Physiology, he found the ground prepared for experimental cardiology, thanks to his former colleague from Prague, Otakar Poupa, during his short stay at this department. Initially, Kruta dealt with the comparative physiology of the heart, especially its automaticity, in the

spirit of Babak (by himself). The monograph, which summarizes his research from this period, is still the only study written in Czech in this area of cardiology. However, he soon sensed that his pre-war themes were coming to interest again, and he continued his earlier works with his young collaborators Braveny, Hlavkova, Sumbera, and others. With its concept of self-regulation of cardiac contractility, Kruta's school soon made its international publicity [18]. When it became clear how the mechanical activity of the heart, triggered by intracellular calcium, depends on membrane events, Kruta's group began to focus on cellular electrophysiology. It was then that they came up with the original, much later accepted theory of multiple electrochemical bonds [19]. A separate branch of Kruta's school of experimental cardiology was represented by Penaz and his students Fiser and Honzikova. Relying on original methodological approaches, they became pioneers of spectral analysis in the study of circulatory reactions. Friendly relations have always prevailed between the Prague and Brno schools; the mutual esteem and respect of their main representatives also had a beneficial effect on young colleagues. In addition, both groups complemented each other very well thematically.

In the 1960s, another, very ambitious workplace was established in Brno – the Center for Experimental Cardiology at the Department of Pathological Physiology of the Faculty of Medicine. At the suggestion of cardiac surgeon Navratil, Vasku and his collaborators Bednarik and Dostal it was embarked on an extraordinarily demanding project of mechanical heart replacement. A large team of engineers, biochemists and surgeons worked on this issue with extraordinary support from the state until 1990. The problem was successfully solved, especially from a technical point of view, and valuable data were obtained on long-term surviving experimental animals. The Center of Experimental Cardiology thus became one of the few workplaces in the world that have brought the development of mechanical heart replacement to the threshold of clinical use. Intensive collaborations arose from this project, especially with the research teams in USA and Japan. Japanese scientists expended the idea of mechanical heart replacement and collaborated with Brno experts (Dobsak) till recent times [13].

Slovak school of experimental cardiology

In Slovakia, experimental cardiology intensively developed from 1955. This initiative began in the Laboratory of Experimental Surgery (later on Institute of Experimental Surgery of the Slovak Academy of Sciences, SAS), founded by prof. Siska. The research was primarily focused on ischemic heart damage, heart storage for transplantation purposes, and the development of devices for extracorporeal circulation [20]. Founding employees, besides Siska, were also Hubka, Holec, Silvay and Sujansky (surgical group) and Fedelesova, Ziegelhöffer, Valachovic, Slezak, Styk, and Gebauer (experimental cardiologists). Fedelesova and Ziegelhöffer studied the possibility of using of exogenous ATP to improve the metabolic state of ischemic myocardium. The results gained worldwide attention, and the institute organized several international symposia on this topic [21]. Slezak was concentrated on the study of ultrastructure of the damaged myocardium [22]. The experimental cardiologists from the Institute of Normal and Pathological Physiology of SAS, e.g. Gero, Gerova, Török, and Smiesko, significantly contributed to the knowledge of adrenergic innervation of the coronary arteries; they developed the method for registering the separate influence of the sympathetic nervous system on the coronary arteries [23,24]. Kellerova with colleagues developed her own ultrasound device for measuring blood pressure in newborns; the existence of a circadian rhythm of blood pressure in newborns was confirmed already in the first days after birth [25]. Experimental cardiology developed also at the Medical Faculty of the Comenius University, particularly in the Departments of Physiology and Pathological Physiology. Antal and colleagues (Hazucha, Stolc, Slezakova) studied functional regulations during muscle work, Barta and his team focused on the regulation of coronary artery contraction by sympathetic innervation under physiological conditions and during extracorporeal circulation [26] and Fizel a Fizelova described an original experimental method of cardiac adaptation to volume overload.

The years 1968-1989 and the foundation of the Society of Experimental Cardiology

The Soviet occupation in August 1968, which started the period of so-called normalization, adversely affected the development of Czech and Slovak experimental cardiology for many years. Poupa, as one of the authors of the memorable manifesto “Two Thousand Words”, emigrated in September 1968; other members of the Prague school also went abroad (e.g. Rakusan, Souhrada, Turek). Big changes also took place in Brno,

where in the early 1970s the activities of the core of Kruta's school were strictly limited. The significant limitation of foreign contacts gradually led to the loss of hopefully developing contacts, to professional isolation and lagging behind the stormy development of world science. At the moment of greatest depression, Pavel Braveny came up with a proposal to save experimental cardiology by creating a professional forum that would enable its intellectual survival and reduce the negative consequences of the "splendid isolation". Together with Bohuslav Ostadal, they founded the Society of Experimental Cardiology (SEC) at the Czechoslovak Physiological Society of the Czechoslovak Medical Society J.E. Purkynje, with the main task of introducing the advances in world cardiology to theoretical and clinical cardiologists [13]. Slovak experimental cardiologists (led by Barta, Antal, Fizel, Fizelova, Gero, Gerova, Ziegelhöffer, and Slezak) and, above all, a large group of important Czech and Slovak clinical cardiologists (e.g. Herles, Lukl, Widimsky, Samanek, Stejfa, Kölbel, Gvozdjak, Riecansky, Stanek, Endrys, Kvasnicka, Dvorak, Siska, and Kuzela) soon accepted this idea. The first working conference of the SEC was held in 1973 in Nove Mesto in Moravia and was devoted to the problems of myocardial contractility (Fig. 1). It was agreed that the meetings would be held alternately in Bohemia, Moravia and Slovakia. The program of the annual meetings was designed monothematically and always "from the molecule up to the patient's bed"; the largest space was always devoted to informal discussion. It can be stated with pleasure that the character of these meetings has been preserved to the present day; in 2023, the 50th working conference was already held; despite the division of the Czechoslovak republic in 1993, Slovak colleagues have always participated.

I n f o r m a č n í d o p i s

I. pracovní sjezd sekce teoretické a experimentální kardiologie, o němž jste byli předběžně informováni a na nějž jste se přihlásili, se bude konat ve dnech 23. a 24. února 1973 v hotelu SKI u Nového Města na Moravě. Přihlášeno je přes 50 účastníků.

Program :

23. II. : 8.00 Zahájení P. Bravený (Brno)
8.30 - 9.00 A. Gutmann (Praha) : Funkční a morfologické vlastnosti kosterního a srdečního svalu a jejich funkční kapacita.
9.00 - 9.30 J. Šumbera (Brno) : Stupňování kontraktility srdeční tkáně.
9,30 - 10.00 První část panelové diskuse (řídí P. Bravený).
17.00 - 17.30 J. Dřímal (Bratislava) : Posobenie digitalisových glykozídov na mechanické koreláty kontrakcie a kontraktilné vlastnosti myokardu.
17.30 - 19.00 Panelová diskuse k tematům prvního dne.
24. II. : 8.30 - 9.00 V. Ježek (Praha) : Vyšetřování srdeční kontraktility v klinickém výzkumu.
9.00 - 10.00 Panelová diskuse (řídí J. Kvasnička, Hradec Král.)
17.00 - 19.00 Pokračování panelu. Závěry. Diskuse k další činnosti sekce.

Fig. 1. Program of the first meeting of the SEC in 1973.

With the passage of the years, it must be stressed that SEC's activities have almost completely fulfilled the ideas of its founders. It helped to maintain an acceptable level of awareness, initiated scientific cooperation, educated a number of young cardiologists and, above all, built cardiology as an indivisible science. Last but not least, it created a friendly atmosphere, which in many cases helped to overcome the very complicated relationships of that time (Fig. 2). Even under difficult conditions, experimental cardiologists tried to reduce their professional delay. In this context, it should be noted that in 1974 František Kölbel managed to organize a meeting of the International Study Group for Research in Cardiac Metabolism in Prague, the predecessor of today's International Society for Heart Research. This enabled a useful confrontation between Czech and European experimental cardiology, the only one for a long time [27].

Fig. 2. Participants of the 40th annual meeting of SEC in 2012.

Experimental cardiologists at the Physiological Institute of CASs (Ostadal, Prochazka, Pelouch, Faltova, later Rychter, Kolar, Ostadalova, Papousek, Sedmera, and Neckar) followed Poupa's tradition and created the Department of Developmental Cardiology. Their main task became the study of the development of the structural, functional and metabolic properties of the heart muscle, important for understanding the ontogenetic changes in its resistance to a lack of oxygen. Special attention was paid to the possibilities of protective influence on the myocardium, especially its adaptation to chronic hypoxia. In a number of cases, the current issue led to the establishment of a very effective cooperation with clinical departments, both in the field of pediatric cardiology (Samanek and his team) and with cardiologists dealing with cardiopulmonary disorders (Widimsky and his team.). At the Institute of Physiology, Krecek's group also continued its research activities in the field of ontogenesis: the developmental aspects of the pathogenesis of hypertension were very successfully studied by a group of young researchers around Jelinek (Zicha, Kunes). History of sixty years of heart research in the Institute of Physiology of the Czech Academy of Sciences was recently summarized by Ostadal and Kolar [28].

However, experimental cardiology was cultivated in Prague also outside the Czechoslovak Academy of Sciences. In 1959, the physiologist Peleska from the Institute of Clinical and Experimental Surgery constructed an unsynchronized direct current defibrillator with his colleagues, and in 1965, together with Bicik (at the Institute of Medical Electronics), they constructed the first Czech implantable pacemaker with a fixed frequency of stimuli. At the experimental department of Institute of Clinical and Experimental Medicine, Heller bred a line of laboratory rats with spontaneous hypertension, Poledne and later on Cervenka analyzed the pathophysiological mechanisms of the development of atherosclerosis and hypertension. Czech leading endocrinologist Schreiber at the IIIrd Department of Medicine of the 1st Faculty of Medicine, together with Kölbel, intensively analyzed the humoral mechanisms involved in the development of cardiac hypertrophy. In the Research Institute of Pharmacy and Biochemistry, a group of experimental pharmacologists around Trcka developed original Czech beta-blocker (Trimepranol). Finally, a group was formed in the Institute of Pathological Physiology of the then Faculty of Pediatrics of the Charles University, interested in the experimental study of pulmonary hypertension (Palecek, Herget, Vizek, later Hampl).

The Brno school did not disappear either. At a time when Krutas' original excellent team was forcibly dispersed, a happy coincidence brought Simurda and his wife to the Department of Physiology of the Faculty of Medicine in Brno: a theoretically educated biophysicist and a medical doctor. Even though they remained at the Research Institute of Medical Technology until 1990, with the remnants of Kruta´s school (primarily Braveny and Sumbera) they achieved several original discoveries in the electrophysiology of the heart cell, the theory of arrhythmogenesis and the effects of antiarrhythmics. Later M. Novakova, former doctoral student of Braveny, opened Laboratory of experimental cardiology ongoing in

Kruta´s and Braveny´s research direction. Penaz and his successors Fiser and Honzikova became leaders in the research of blood pressure regulation and intensively collaborated with numerous clinicians (e.g., Semrad, Labrova, Toman, Stejfa, Blaha, Hrstkova). At present, their Laboratory of non-invasive cardiology is run by Z. Novakova and co-workers (Budinska, Pekar, and Novak). Jiri and Milena Simurda returned to the Department of Physiology and established new – purely electrophysiological – laboratory. Its program (based on voltage-clamp and patch-clamp experiments) was expanded to include mathematical modeling. The Laboratory for excitability and its disorders is now run by Bebarova and co-workers (Pasek).

However, experimental cardiology was far from being limited to Prague and Brno. A sort of imaginary thematic link between Prague developmental cardiology and Brno electrophysiology was formed by the cardiologists of the Pilsen Institute of Physiology, who consistently devoted themselves to the ontogenetic development of adrenergic innervation (Vlk, Slavikova, Kuncova) and postnatal changes in the electrical manifestations of heart activity in various species of mammals (Pucelik). Latern on Stengl with colleagues started with the analysis of the role of cardiovascular system in the pathogeny of infectious diseases. A characteristic feature of experimental cardiologists from the Faculty of Medicine in Hradec Kralove was the close cooperation of theoretical and clinical cardiologists, especially in the field of the regulation of cardiac activity (Okrouhlicky, Kvasnicka, Endrys). Gersl, Adamcova and later on Sterba and Simunek (Faculty of Medicine and Faculty of Pharmacy) started with the very important topic: cardiotoxic effects of antracycline cytostatics. Finally, there was a group of embryologists in Olomouc (Faculty of Medicine), led by Obrucnik, who studied the ultrastructural development of the myocardium, and pathologists led by Dusek, an expert in experimental cardiac necrosis who has been trained by the legendary Rona in Canada [13].

In Bratislava, Institute for Heart Research became a part of the newly established Center of Physiological Sciences of SAS. Following global trends, cardiological research was concentrated on molecular approach, such as the molecular mechanisms of the calcium paradox, enzyme systems at the subcellular level during ischemia (Ziegelhoffer, Ravingerova). The research covered also a new modern histochemistry for early detection of ischemic damage (Slezak, Tribulova). Moreover, in 1988, the studies of mechanisms of ischemia/reperfusion injury started, including studies of oxidative stress and calcium overload, as well as cardioprotection using ischemic preconditioning (Ravingerova, Ziegelhoffer), hyperbaric and hypothermic heart storage, synchronized retrograde perfusion of the coronary vein, and perfusion of the isolated heart (Ziegelhoffer, Styk, Gabauer, Dzurba, and Vrbjar).

Cardiovascular research continued also in the Institute of Normal and Pathological Physiology of SAS. Gero with colleagues analyzed very successfully the reactivity of peripheral circulation, Kellerova the ontogenetic approach of the changes in the blood pressure, Pechanova and her colleagues contributed to the investigation of the role of nitric oxide in cardiovascular system, Ruttkay-Nedecky studied the mechanisms of cardiac arrhythmias, later on Zahradnik and Zahradnikova (in then the Institute of Molecular Physiology and Genetics SAS) investigated molecular mechanisms of the role of calcium in the excitation-contraction coupling. As it has been mentioned above, to the development of cardiovascular research in Bratislava contributed significantly also experimental cardiologists from the Faculty of Medicine of the Comenius University (Antal, Barta, Fizel, Fizelova, Zlatos, later on Simko). In the newly founded Jessenius Faculty of Medicine in Martin very active group of cardiorespiratory physiology was created (Tomori, Ivanco, Korpas, later Javorka sen. and Javorka jun.); together with Korec (Faculty of Medicine Kosice) they created a school of respirology, including cardiorespiratory relationship, chrono-physiology and sleep medicine. In addition, Javorka and his colleagues were dealing with blood pressure and heart rate variability, especially in young individuals. Moreover, in Martin Faculty of Medicine, Department of Biochemistry studied the role of free radicals and calcium overload on the heart injury, including mitochondria and proteins modifications (Kaplan, Lehotsky).

The mere list of laboratories that devoted themselves to experimental cardiology between 1969 and 1989 is remarkable for a small country. A respectable list of their priority results, which have not been carried away by time and which helped to carry the banner of this discipline into the age of science, would be equally venerable. It is just a shame that the great intellectual potential, which was undoubtedly present in our experimental cardiology, could not be used in proportion to his possibilities. We could have been elsewhere!

Development after 1989

The aim of this review was not to evaluate Czech and Slovak experimental cardiology in the period after 1989; that would require a separate article. We merely attempted to highlight the fundamental changes that the new era brought to the development of scientific activities.

The events of November 1989 represent the most valuable gift to the scientific world: the "splendid isolation" ended and Czech and Slovak science went out into the world. First came the altruistic invitation of kind foreign colleagues, so that the experimental cardiology gained the necessary self-confidence relatively quickly. At the same time, it was clear that excuses for the past joyless years will not suffice for long, that originality must be proven. Of course, all this also applies to experimental cardiology. Where it was still possible, old contacts were established, long-standing literary acquaintances were personified, and priority results timidly found their way to scientific meetings and prestigious journals. The explosion of study stays of young scientists began to bear fruits, and the intellectual and methodological background of Czech and Slovak laboratories gradually improved. In this context, modern molecular cardiology approaches, without which we can no longer imagine current experimental research, began to be developed with great delay and literally on the green field. The grant system established a competitive approach to financial resources and undoubtedly contributed to the improvement and reduction of the scientific base. However, the decisive role of finances in cardiology unfortunately led to the limitation of the research activity of clinical departments, which logically limited the traditionally good cooperation with theoretical laboratories. What's more, the low wages of graduates have led to the departure of many promising candidates to the arms of pharmaceutical companies. However, it seems that even here the situation is starting to improve slightly. The increasing importance of postgraduate study has brought a relatively large number of young people to the laboratories in recent years, and thus significantly reduced the considerably increasing average age of experimental cardiologists.

The advantage of our experimental cardiology was that it entered the new era organizationally prepared; because SEC, with its philosophy, organization and scientific activity, represented a unique national scientific society even on a global scale. This was undoubtedly one of the decisive reasons that caused its invitation by the Committee of the International Society for Heart Research (ISHR), the only world organization of experimental cardiologists, to organize the World Congress in 1995 in Prague (Fig. 3). With distance, it can be stated that the first official meeting east of the Ore Mountains successfully entered in ISHR history and became the culmination of activities of SEC to date. In the challenging scientific program, it was also possible to adequately apply traditional, i.e., adaptive and developmental cardiology and electrophysiology. Golden Prague, a rich social program and a friendly atmosphere also contributed to the big success of this scientific event.

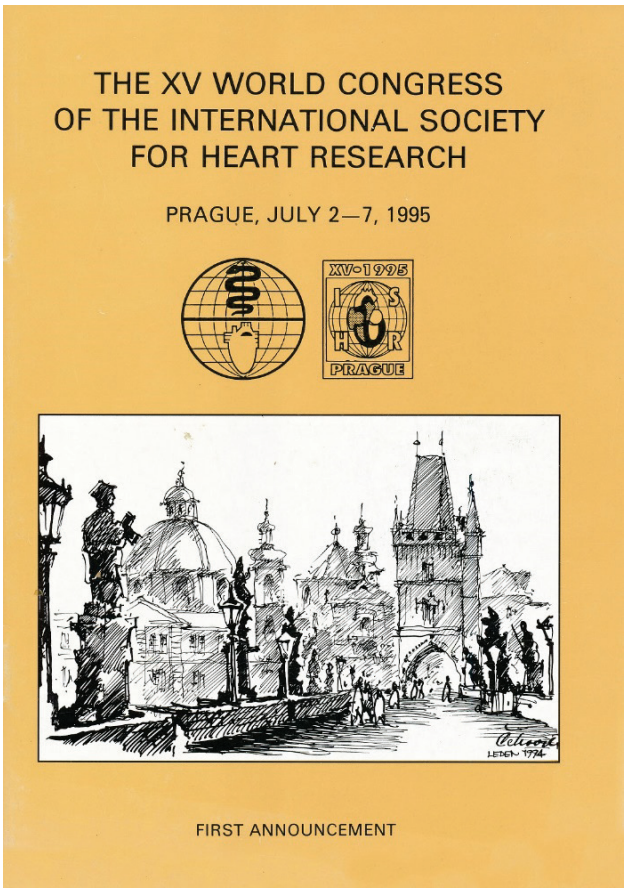

Fig. 3. First announcement of the XV World Congress of the International Society for Heart Research, organized in Prague in 1995.

And how will experimental cardiology develop in the coming decades? We live in the era of molecular medicine, and the impact of basic research on clinical practice has never been greater. Recent advances in molecular biology and genetics have opened the door to substantial advances in many medical fields, including cardiology. With the development of new knowledge about the mechanisms of possible drug effects on the cardiac cell, the pharmaceutical industry is also

developing dramatically. The development of new drugs requires carefully prepared clinical studies that would help in the search for the most effective therapeutic procedures. Research testing theoretically based working hypotheses on small groups of patients thus logically lost its importance, and the interest of clinical cardiologists is focused mainly on the results of large multicenter studies. However, this stormy development of cardiology as a scientific discipline also has its negative consequences worldwide: experimental and clinical cardiologists gradually cease to understand each other: the focus of the two previously inseparable allies is so different that it is difficult to find a common interest. On the one hand, there is a concentration on "evidence-based medicine", on the other, there is an orientation towards molecular and cellular mechanisms, often without an effort towards the possible clinical use of the tested mechanisms. We are convinced that this trend is not good. We must realize that the impressive progress in the prognosis, diagnosis and therapy of cardiovascular diseases would be unthinkable without the most significant discoveries of the past: they include, for example, the ECG, the Framingham Epidemiological Study, the lipid hypothesis of atherosclerosis, echocardiography, thrombolysis, defibrillators, modern pharmacotherapy. It should be emphasized that all the described achievements are the result of very close cooperation between experimental and clinical cardiologists. It proves that this cooperation has a long tradition in cardiology and is the driving force of the scientific progress. The situation has recently significantly improved. However, we are still far from an ideal state. Let's find a way to each other, there are still more than enough tasks for the joint work of experimental and clinical cardiologists (Fig. 4).

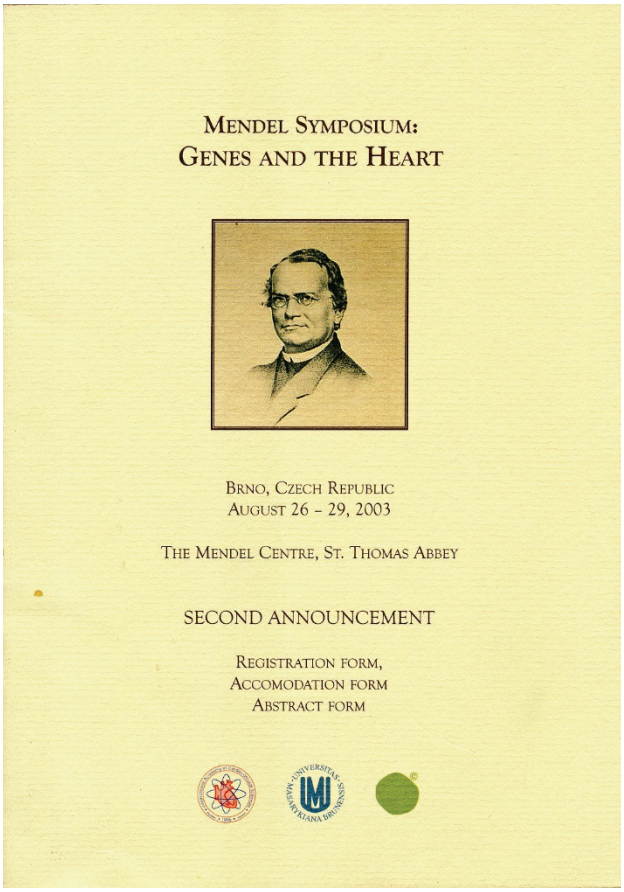

Fig. 4. Second announcement of the international Mendel Symposium: Genes and the Heart, organized in Brno in 2003.

However, it is impossible to keep up with the rapid development of world cardiology without a constant influx of educated and enthusiastic young adepts of science. How to achieve that? The situation is far from simple. Science was never a way to get rich and required sacrifice and renunciation. Sometimes they have to wait a very long time for a stimulating success, and the impatient persons therefore give up. Competition with the clinical medicine, private business or offers from pharmaceutical companies is too strong, so that only the most resistant survive. How to face this unfavorable situation? In the first place there is obviously the improvement of the material security of theoretical cardiologists; another condition is an attractive research topic, a passionate supervisor and the possibility of working in an experienced team. A good clinical cardiologist should be interested in experimental research in his area of expertise, and likewise a wise experimental cardiologist should listen to clinical questions. We can only hope that the achievements of contemporary cardiology will attract as many young enthusiasts as possible and thus help to increase the prestige of cardiology as a scientific discipline.

Conclusions

50 years is a sufficiently long period to look back and evaluate the contribution of our Society of Experimental Cardiology (SEC) to the development of the scientific discipline in the Czech and Slovak Republic. We can responsibly state that the foundation of SEC has fulfilled its purpose: it has brought experimental and clinical cardiology closer together, which is so essential for the development of this important medical discipline. We can only wish for it to maintain its significance and popularity in the future as well.

Conflict of Interest

There is no conflict of interest.

Acknowledgements

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References

1. Trávníčková E, Trojan S. Profesor fysiologie Jan Evangelista Purkyně. In: *Jan Evangelista Purkyně, život a dílo*. Avicenum, Praha, 1986, pp 201-215.
2. Fišer B, Peňáz J. Purkyňova srdeční vlákna. In: *Jan Evangelista Purkyně, život a dílo*. Avicenum, Praha, 1986, pp 216-226.
3. Purkyně JE: Nowe spostrzenia i badania w przedmiocie fizyologii i drobno widzovéj anatomii. Rocznik Wydzialu lekarskiego w uniwersytecie Jagellonskim. In: *Opera omnia III*. JE Purkyně (ed.), Spolek českých lékařů, Praha, Krakow, 1839, pp 201-215.
4. Ošťádal B: O sací síle srdce. In: *Jan Evangelista Purkyně, život a dílo*. Avicenum, Praha, 1986, pp 227-229.
5. Guyton AC. *Textbook of Medical Physiology*. Philadelphia: W.B.Saunders, 1991.
6. Ošťádal B. Jan Evangelista Purkyně a fyziologie kardiovaskulárního systému. Živa 2011;5:234-235.
7. Ošťádal B: Jan Evangelista Purkyně a historie české experimentální kardiologie. In: *Jan Evangelista Purkyně a jeho význam pro současnou a budoucí medicínu*. SVAČINA Š, SKRHA J, TRC T (eds). Mladá fronta, Praha, 2017, pp 218-225.
8. Fejfar Z. *Česká kardiologie a kardiologové. Črty z historie*. Praha, Galén, 2001.
9. Trojan S, Trávníčková E. *125 let Fyziologického ústavu Fakulty všeobecného lékařství Karlovy University*. Vlastním nákladem, 1976.
10. Bravený P, Franc Z: In: *Edward Babák, Nadace Universitatis Masarykiana*. Brno: Masarykova Universita, 1997.
11. Křeček J. Epitaf E.B. In: *Edward Babák, Nadace Universitatis Masarykiana*. BRAVENÝ P, FRANC Z (eds), Masarykova Universita, Brno, 1997, pp 120-122.
12. Poupa O. *Syndrom kolibříka*. Praha; Galén, 2000.
13. Ošťádal B, Bravený P: Experimentální a vývojová kardiologie. In: *Z. Fejfar: Česká kardiologie a kardiologové, Črty z historie*. Praha: Galén; 2001; pp 223-248.
14. Kopecký M, Daum S. Tkáňová adaptace na anoxii v myokardu krysy. Čs Fyziol 1958;7:518-521.
15. Poupa O, Krofta K, Procházka J, Turek Z. Acclimatization to simulated high altitude and acute cardiac necrosis. Fed Proc 1966;25:1243-1246.
16. Turek Z, Kalus M, Poupa O. The effect of isoprenaline pretreatment on the size of acute myocardial necrosis induced by the same drug. Physiol Bohemoslov 1966;15:353-356.
17. Ošťádal B. Developmental cardiology. Cor Vasa 1994;36:65-67.
18. Kruta V, Bravený P. Rate of restitution and self-regulation of contractility in mammalian heart. Nature 1963;197:905-906. https://doi.org/10.1038/197905a0
19. Bravený P, Šumbera J, Kruta V. Aftercontractions and restitution of contractility in isolated guinea-pig auricles. Arch Int Physiol Biochem 1966;74:169-171. https://doi.org/10.3109/13813456609059899
20. Siska K, Holec V, Fedelesova M, Ziegelhöffer A, Slezak J, Styk J, Petras J, Tregerova V. Transplantation 1970;9:93-109. https://doi.org/10.1097/00007890-197002000-00002
21. Ziegelhöffer A, Ravingerova T, Tregerova V.Bartel S, Krasuse EG, Tribulova N, Okolicany J, Slezak J. Partial prevention of calcium patradox in isolated perfused rat hearts by Diltiazem. Biochim Biomed Acta 1989;48:S96-S101.
22. Slezak J. Ultrastructural changes in early stages of experimentally induced myocardial infarction. Folia Morphol 1969;17:228-245.

23. Gerova M, Barta E, Gero J. Sympathetic control of major coronary artery diameter in the dog. Circ Res 1979;44:459-467. https://doi.org/10.1161/01.RES.44.4.459
24. Török J. Influence of extravascular pressure on changes induced in vascular resistance in the small intestine by elevated venous pressure. Physiol Bohemoslov 1980;29:63-71.
25. Kellerova E, Kittova M. Diurnal periodicity of circulatory functions in man. Activ Nerv Super (Praha) 1980;22:63-64.
26. Barta E, Kuzela L, Kvetnansky R, Siska K, Babusikova F, Torda M, Cornak V, Horecky J. Activity of sympathetic nerves in heart during cardiopulmonary bypass in patients. J Cardiovasc Surg (Torino) 1976;17:174-177.
27. Ošťádal B, Bravený P, Ostadal P. Historie české experimentální kardiologie. In: *90 let České Kardiologie.* TÁBORSKÝ M et al (eds), Mladá fronta, Praha, 2019, pp 329-348.
28. Ošťádal B, Kolář F. 60 years of heart research in the Institute of Physiology of the Czech Academy of Sciences. Physiol Res 2024;73(Suppl 1):S35-S48. https://doi.org/10.33549/physiolres.935337