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PHENOMENON OF DEMIKHOV.

At N.V. Sklifosovsky Institute (1960–1986). V.P. Demikhov and his experiments in the field of organ transplantation in 1971–1972

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Abstract

Having reviewed the archival documents, we enlightened the results of research performed by V.P. Demikhov and the employees of the Organ Transplantation Laboratory at the N.V. Sklifosovsky Research Institute, as well as V.P. Demikhov's life and work in 1971–1972. During those years he continued to conduct the research required, as he believed, for practical healthcare. In 1971, together with M.M. Razgulov, he proposed a method for connecting blood vessels, a method for transplanting an upper limb together with a scapula, repeated experiments previously carried out on dogs, on human corpses (revitalization of a cadaveric

heart, monitoring its activity using electrocardiography, implanting an additional heart into the cadaver's chest in order to implement the technique in clinic for the treatment of heart failure), presented the results of his research at the X International Congress on Cardiovascular Diseases. We have also shown that in 1971–1972 V.P. Demikhov performed 76 experimental interventions, most of which were aimed at the development of a technique for transplanting an isolated cardiopulmonary complex and heart, as well as the technique for their revitalization. It should be noted that all the methods of organ transplantation developed by him were intended for implementation in clinic. However, no method was introduced into clinic during his lifetime. The fact is that the studies of V.P. Demikhov in the field of organ transplantation could not be adequately supplied from the material, technical and economic point, since they did not correspond to the main trends of the scientific and practical activities of the N.V. Sklifosovsky Institute – to improve the organizing system of rendering an emergency and urgent care to the population of Moscow in acute diseases and injuries.

Keywords: history of transplantology, V.P. Demikhov, experimental transplantology, 1971–1972

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Introduction

In the previous article (Transplantologiya, 2022'4), we described and analyzed the results of V.P. Demikhov'work and that of the Organ Transpltation Laboratory at the N.V. Sklifosovsky Institute for the period from 1969–1970. The present article covers the research and experimental activities of V.P. Demikhov and his Laboratory in 1971–1972.

Research conducted in the Organ Transplantation Laboratory at the N.V. Sklifosovsky Institute in 1971

Recall that in 1970 V.P. Demikhov was elected the member of the Academic Council of the N.V. Sklifosovsky Institute and was striving to regularly attend its Meetings (Fig. 1).

Fig. 1. At the Meeting of the N.V. Sklifosovsky Institute Academic Council. (From left to right): V.P. Demikhov, M.M. Razgulov, I.I. Shimanko, P.N. Petrov. 1970s [1]

At the meeting of the Council on February 3, 1971, there was an approbation of the doctoral Thesis of G.A. Pafomov, Candidate of Medical Sciences, the Head of the Laboratory for Blood Transfusion and Tissue preservation, on the topic: "Biological characteristics of the blood of the suddenly deceased and its use in clinical practice". The scientific

advisor of the doctoral research scholar was Professor B.A. Petrov. The doctoral research scholar reported that for the period from 1958 to 1968, 12 tons of cadaveric blood were procured and transfused to the injuried at the N.V. Sklifosovsky Institute by using an original developed method.

After the debate was opened, V.P. Demikhov asked the question: “Has the isotonic method been used to assess the viability of donor and cadaveric erythrocytes? Was their viability time determined in recipients? What is the cost of cadaveric blood?" – "We used the radionuclide imaging technique, - G.A. Pafomov answered. - The cost [of cadaveric blood] is about 14–15 rubles per liter.” The speaker refrained from answering the question about the viablility time of transfused blood erythrocytes [2, p. 51].

After several speeches in the debate, the Thesis was unanimously recommended for defense. Let us, however, pay attention to the question to which the speaker did not answer. The fact is that in the early 1970s. V.P. Demikhov conducted experiments on the blood replacement in animals (dogs, pigs, monkeys) with cadaveric human blood; that was why he was interested in the destiny of the transfused (transplanted) blood (homologous tissue) in the recipient's body. Unfortunately, the study of homologous blood survival was outside the scope the Thesis research.

On February 16, 1971, there was a Joint Meeting of the Party Organization of the N.V. Sklifosovsky Institute and its Academic Council. V.P. Demikhov was absent from the Meeting. The Meeting was chaired by Professor N.S. Uteshev. Professor A.P. Kuzmichev, Doctor of Medical Sciences, the Deputy-Director for Science and Research presented a “Report on the scientific research of the Moscow City Research Institute for Emergency Medicine named after N.V. Sklifosovsky. The speaker covered the main topic of the Institute research activity “*a further improvement of emergency care for acute*

diseases and emergency conditions", which, in addition to physicians, was to be provided by 112 researchers, including 13 professors, 21 doctors of science (one of whom was V.P. Demikhov), and 69 candidates of sciences. The main scientific trends developed by the Institute scientists were: (1) hypertension, coronary and vascular insufficiency; (2) trauma and injuries; (3) anesthesiology and intensive care; (4) abdominal surgery; (5) surgical emergency gynecology; (6) the treatment of acute poisoning.

Describing the work in different directions, on the problem "Trauma and traumatism" the speaker mentioned the transplantation of homologous bone and autologous skin. Having devoted almost 8 pages of the report to the work on the main scientific topic, A.P. Kuzmichev said a few words about the issue of "Transplantation, the preservation of organs and tissues":

> "In 1970, 6 studies were to be conducted on the issiue, and 4 of them were exploratory by nature. The conduct of laboratory, anatomical, physiological, and experimental studies is justified by the ever-increasing number of vital organ transplantations" [2, p. 81–90].

On March 3, 1971, the Academic Council heard a report by Professor B.G. Zhilis about the work of the Department of Anesthesiology and Intensive Care. The Head of the Department spoke about the work of his department, but for some reason did not mention the joint two-year work with the Organ Transplantation Laboratory on the topics: "On the revitalization of the heart and the whole human body using a mechanical heart (according to the V.P. Demikhov's method)" and "Creation of physiological conditions (blood circulation, respiration, nutrition) to maintain the function and preserve vital organs for their transplantation to humans" [2, p. 111–139].

Apparently, therefore, V.P. Demikhov considered it possible to add from himself:

> "Complexing is one of the most important problems at the Institute at the present stage <…>. Being the Head of the Organ Transplantation Laboratory, I am ready to take part in any kind of integration. I have conducted complex studies with various foreign medical institutions, in particular, with medical institutions of the GDR, with whom we studied the EEG in two-headed animals [1]. Unfortunately, only few at the N.V. Sklifosovsky Institute are collaborating with the Unit headed by me. Among these few, I should mention the Clinic of Anesthesiology and Intensive Care" [2, p. 102].

Another feature of that Meeting was the request of M.M. Razgulov, a surgeon of the Central Polyclinic of the USSR Ministry of Railways (MPS) to the Academic Council to apply to the Head Physician of the MPS polyclinic for granting him, M.M. Razgulov, a sabbatical to complete his research on the Thesis for the Candidate for Science Degree on the topic: "The development and experimental justification of the method of mechanical connection of blood vessels with clips." V.P. Demikhov requested the members of the Council to satisfy the request of the doctor, for whose Thesis he was a scientific advisor [2, p. 102]. Note that M.M. Razgulov became the first and last Candidate of Sciences officially trained by V.P. Demikhov for all his 25 years of work at the N.V. Sklifosovsky Institute (Fig. 2).

[1] It is about the complex experiments of the central nervous system function in two-headed dogs conducted jointly with the Academy of Sciences of the GDR (P. Kokkalis) in 1959 - early 1960s.

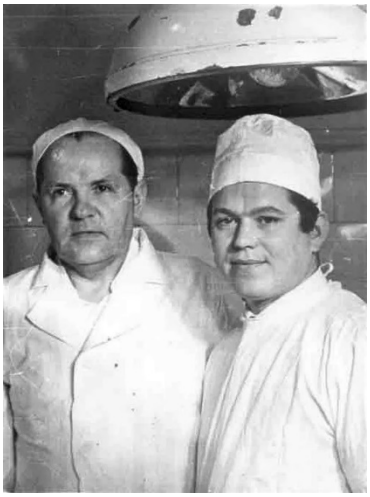

Fig. 2. V.P. Demikhov and M.M. Razgulov. 1970s [3]

In summer 1971, the XXIV Congress of the International Society of Surgery, the first and still the only one in our country, was to be held in Moscow. On March 24, 1971, at the Academic Council Meeting, the issue of preparing the N.V. Sklifosovsky Institute for that event was discussed. Professor B.D. Komarov stressed that Congress delegates are planning to visit the Institute. Following him, Professor A.P. Kuzmichev listed the Units that can be shown to the participants: the Laboratory for Blood Transfusion and Tissue Preservation, the Operating Theatre, the Cardiology Department with Intensive Care beds, the Department of Anesthesiology and Intensive Care. In the manuscript of A.P. Kuzmichev's presentation, in brackets against the names of the Departments there were listed the employees who were supposed to meet with foreigners. The name of V.P. Demikhov was among them, although the name of his Laboratory was not on the list. The rest of the clinics and departments, as noted by A.P. Kuzmichev, will be shown if necessary [2, p. 142].

At the Council Meeting on June 20, 1971, the issue of the Institute participation in the XXIV Congress of the International Society of Surgery was again raised. But if at the preceding meeting, the visit of the

Congress participants and guests to the Organ Transplantation Laboratory was not planned, at that meeting, the issue was raised by Professor B.A. Petrov:

> "We should also consider the possibility of the guests visiting the Laboratory headed by V.P. Demikhov. But *guests cannot be led into the setting, in which the laboratory is currently located* (hereinafter, in direct speech, italics are ours - *Auth.*). At the same time, *we can say with confidence that there will be many people who want to visit the laboratory*. Apparently, it is necessary to prepare the demonstration for the guests to see the operations that V.P. Demikhov has performed, for example, a dog with a transplanted head. You should think about a room where you could show these animals to guests" [4, p. 36].

As a result, in June 1971, the Organ Transplantation Laboratory was included in the list of Units to be shown to the guests of the Congress [4, p. 36]. The Congress was held in Moscow from 23 to 28 August, 1971. Its opening took place in the Kremlin Palace of Congresses. B.V. Petrovsky was elected the Chairman of the Congress. The International Society of Surgery was headed by P. Lorthioir from Brussels in those years (from 1969 to 1975). The final program of visiting the N.V. Sklifosovsky Institute by the Congress delegates looked like this: an interview of guests with the Director of the Institute, his Deputy for Science and Heads of the Clinics. Then the guests were shown the Operating Building, the Laboratory for Blood Transfusion and Tissue Preservation, the Department of anesthesiology and Intensive Care, a specially prepared exhibition and a museum [4, p. 41a].

Note that on August 27, 1971, V.P. Demikhov and M.M. Razgulov together with a group of military surgeons (M.N. Anichkov, I.V. Vigdorchik, N.M. Anichkov) made a 10-minute presentation on the

topic “On new methods of connecting a transplanted natural and artificial heart to create additional blood circulation” at the Symposium "Auxiliary circulation and artificial heart" of the X International Conference on Cardiovascular Diseases held within the framework of the XXIV Congress of the International Society of Surgery. The Conference was held in the *Oktyabr Cinema and Concert Hall* on Kalinin Avenue. Report by V.P. Demikhov completed the morning session, which was chaired by W. Lillehei from New York (USA).

On November 3, 1971, the agenda of the Academic Council Meeting again included the issue “On the plan of scientific research of the N.V. Sklifosovsky Institute for 1972". V.P. Demikhov spoke again in the debate:

> “I want to draw the attention of the members of the Academic Council to the following fact: experiments are being conducted on pigs in the Organ Transplantation Laboratory[2]. We transfuse human blood (obviously, cadaveric blood) to *pigs*, conduct experiments to revitalize pigs, and plan to connect a cardiopulmonary complex. These researches require large expenditures of both scientific staff, and also of service personnel. <…> I ask the Academic Council to take action on this issue” [4, p. 139].

The Scientific Council adopted the resolution: (1) to approve the Plan for 1972; (2) to provide for a further increase in the completing of the topics; (3) When drawing up a research plan for the next years, to provide for an increase in the number of studies on such topics as "Thermal Injury", "Emergency Surgical Conditions", "Express-Diagnosis Methods" and a number of others. There was no mention about V.P. Demigod in the resolution. In the attendance lists of several next

[2] In 1971, the structure of the N.V. Sklifosovsky Institute was changed: departments and centers appeared instead of clinics, and the Organ Transplant Laboratory was renamed in the Organ Transplantation Laboratory.

meetings of the Academic Council, against the name of V.P. Demigod there were the signature of L. Rothko, an employee of his Laboratory [4, p. 160].

In December 1971, the traditional Meeting of the Council took place, at which the “Report of the N.V. Sklifosovsky Institute for 1971" was discussed. There was an explanatory note to the Report. In the topic of "Injury and Traumatism", there are no R&D Reporting Sheets by V.P. Demigod, but a new section “Development of methods for ensuring effective organ and tissue transplantation” appeared, where the R&D Reporting Sheets of his Laboratory turned to be [6, p. 146].

R&D Reporting Sheet No. 43.

Topic: A **new method of connecting blood vessels with metal clips and its experimental justification**[3].

Project Leader: V.P. Demikhov.

Investigator: M.M. Razgulov.

Abstract: An original device was invented, which was simpler as compared to vascular stapling devices (Fig. 3). Forty three experiments were made on 41 dogs; 103 blood vessels of 2.5 to 8 mm in diameter were stitched. Efficiency and absence of complications within 1.5 years have been proven.

Recommendations: After patenting, the device can be introduced into clinical practice [6, p. 147].

R&D Reporting Sheet No. 44.

Topic: **Assessing the functional state of transplanted and preserved heart**.

Project Leader: V.P. Demikhov.

Investigator: V.M. Goryainov.

Abstract: A total of 83 ECGs were taken in 1971 in experiments on dogs and during resuscitation of the heart from corpses delivered by ambulance, and

[3] Thesis by M.M. Razgulov for the Degree of Candidate of Science.

during implantation of a [revitalized] heart from human corpses to the vessels of a pig [6, p. 148].

Fig. 3. Device for vascular suture designed by M.M. Razgulov. 1970s [3]

R&D Reporting Sheet No. 45.

Topic: **Anatomical and experimental substantiation of the transplantation of various organs and limbs.**

Abstract: Experimentally and on cadavers, a scheme was developed for implanting the 2nd, additional, heart into the chest (without removing one's own). According to this scheme, operations on patients with irreversible and life-threatening injuries to the heart can be easily performed. According to world statistics, only 1% of all deaths from heart failure are caused by damage to the right ventricle, so removing the entire heart in 99% is not advisable. The transplanted additional heart can perform the function of a left ventricle affected by a heart attack.

Anatomically and experimentally, an original scheme was also developed for transplanting a hand with a scapula without the need for suturing muscles and tubular bones. According to this scheme, a human hand transplant can be relatively easily performed.

Recommendations: Both above operations, if necessary, can be recommended for clinical practice clinical practice in strict indications.

Note: The results were reported at the X International Conference on Cardiovascular Diseases (Fig. 5)[4] (V.P. Demikhov, V.M. Goryainov) [6, p. 149].

[4] The Conference was held within the framework of the XXIV Congress of the International Society of Surgery.

Fig. 4. At the X International Conference on Cardiovascular Diseases (from left to right): V.P. Demikhov, A.G. Lapchinsky, Yu.M. Lopukhin. Moscow, 1971 [1]

For those who are familiar with our previous article [7], it is not difficult to guess that Reporting Sheet No. 45 refers to the concept of circulatory support formulated by V.P. Demikhov back in 1947. Only in the 1960s. at the Institute of Clinical and Experimental Surgery of the Ministry of Health of the USSR under the guidance of Academician B.V. Petrovsky, and in the 1970s. at the Institute of Organ and Tissue Transplantation of the USSR Academy of Medical Sciences under the guidance of Professor V.I. Shumakov, the work began on the creation of a mechanical heart and an artificial left ventricle to bypass the left heart in patients with severe heart failure.

But how V.P. Demikhov was ahead of his time then raising the issues of auxiliary and replacement blood circulation if clinical studies on those topics began at the N.V. Sklifosovsky Institute only in 2006 when Professor M.Sh. Khubutia was appointed to the position of its Director:

> "In 2006, M. Sh. Khubutia [was] appointed Director of the N.V. Sklifosovsky Research Institute for Emergency Medicine. On his initiative, new scientific and clinical divisions were established at the Institute: the Department of Emergency Cardiology and Cardiovascular Surgery, including the Department of Emergency Cardiac Surgery, Assisted Circulation *and* Heart *Transplantation* (hereinafter, in direct speech, italics are ours - *Auth*.);

> The Department of Cellular and Tissue Technologies; the Department of Laboratory Diagnosis; a group of *kidney and pancreas transplantation* has been formed and is actively working , <…> Pilot studies on *intestinal and lung transplantation have begun* ”[5].

It is clearly seen that most of the operations that V.P. Demikhov proposed to transfer to the clinic in the early 1970s, were introduced only in the mid-2000s, but at a higher level of technological capabilities. It turns out that within the walls of the N.V. Sklifosovsky Institute V.P. Demikhov was ahead of his time by at least 35 years[5].

Let us also pay attention to the fact that there were only three R&D Reporting Sheets on the work of his Laboratory in 1971, which was fewer than in 1968 (4 Reporting Sheets), in 1969 and 1970 (7 Reporting Sheets each). And his name was not mentioned in the research on the topics "Trauma and injuries", "Anesthesiology and Intensive Care" and "Cardiovascular diseases". On the other hand, a new topic appeared in the Institute Report "General and Special Immunology" on the research performed by the Department of Tissue Preservation with an immunology group created in 1971 that was separated from the Laboratory for blood Transfusion and Tissue Preservation [8]. Note, however, that we were talking about the study of the biological incompatibility of tissues (bones, skin, etc.), rather than organs.

[5] Liver transplantation at the N.V. Sklifosovsky Institute began earlier, in 1999, when the Moscow City Center for Liver Transplantation and the Department of Acute Surgical Diseases of the Liver and Pancreas were established at the Institute. From 1999 to 2011, the Center and the Department were headed by the Doctor of Medical Sciences A.V. Chzhao.

Research conducted in the Organ Transplantation Laboratory of the N.V. Sklifosovsky Institute in 1972

On February 2, 1972 Academic Council of the Institute. N.V. Sklifosovsky reviewed the Plan of Research for 1972. Professor B.D. Komarov made the presentation:

> "Today, we can say that research planning has been undertaken rather than according to a specific program, but at the discretion of the Heads of scientific departments in terms of individual planning. It is not right. *It is necessary to work according to a single integrated program, which state should predictably coordinate the efforts of all scientific departments in order to achieve a single goal - to further improve the system of emergency medical care. During 1972, all the Institute Units should revise their research plans, taking into account the main tasks the Institute faces* (our italics - *Auth.*). <…>
>
> Our Institute works mainly for practical public health, that is, according to the principle of implementing basic scientific achievements into practical public health. But the Institute currently [is] not at a very high level <...> If we compare our data with those of, for example, the Institute of Cardiovascular Surgery named after A.N. Bakulev, it turns out that our examination of patients is not at a sufficiently high level[6].
>
> The economic costs per employees are high, and the amount of scientific product is not very large <...> We intend to do a lot of work in 1972 and in subsequent years to evaluate the effectiveness of our Institute activities. At present, the Institute has 5 specialized departments: of clinical and surgical profile; clinical and trauma profile; clinical and therapeutic profile; medical and clinical profile; and scientific and theoretical profile. *Scientific and practical work in accordance with these profiles should be carried out in a common direction - further improvement of rendering emergency medical care to the population* (our italics - *Auth.*)" [9, p. 5–6].

[6] Here he meant the number of diagnostic examinations per 1 patient.

Thus, the report presented the problems, which solution was proposed to be worked on by the leadership of the Institute and its staff in the near future: coordination of research plans, increasing the efficiency of employees, introducing scientific achievements into practical healthcare, improving the system of emergency medical care for the population of Moscow.

A month later, on March 1, 1972, at a regular Meeting of the Academic Council, Professor B.D. Komarov made a report on the topic "On the implementation of the decisions of the Executive Committee of the Moscow Council of May 21, 1971." Approximately the same words were heard from the podium as when considering the Institute plan of research for 1972, but it was emphasized that "*the main goal the Moscow Council set in its Resolution was that the N.V. Sklifosovsky Institute should become the main institution for organizing Emergency Medical System and analyzing its state in Moscow*" [9, p. 26–30].

> "Over the past 10 years," said B.D. Komarov at the end of his speech, - in the field of surgery and other services, work is complicated by a trend that leads to the fact that most scientists have left these problems, as they began to intensively develop the problem of cardiovascular pathology and related disciplines. *As for experimental studies, it can only be noted that in this regard <…> the Organ Transplantation Laboratory remains to be desired in better planning of its research* <…> (our italics - *Auth.*)" [9, p. 41].

Further, in the Director's report, criticism was made against the Laboratory of V.P. Demikhov, which meant that the Head and his employees made the research on the topics not agreed with the Administration.

After the director, N.S. Uteshev, V.P. Okhotsky, M.K. Shcherbatenko, O.I. Vinogradova, A.V. Rumyantseva, M.I. Ryabov,

A.P. Golikov, and Yu.M. Galperin spoke in turn. All of them supported the Director, while criticizing themselves and the work of their departments. The leitmotif was the desire to *draw up an integrated program on all topics and a unified implementation of the research plan for the five-year period* [9, p. 42].

V.P. Demikhov asked for the floor.

> "Our esteemed Professor Komarov touched upon the work of the department I am in charge of. In this regard, I would like to make a number of reminders and objections.
>
> I have been in charge of the organ transplantation laboratory for many years, and for many years I have sought to have it moved to the N.V. Sklifosovsky Institute for implementing the results obtained rather than for only experimental work. In 1960, the laboratory I was in charge of[7] was transferred here by the decision of the Central Committee of the Party. Immediately the question arose of implementing the method of kidney transplantation in clinic[8]. <...>
>
> Now all experiments on organ transplantation abroad have been implemented: lungs, liver, pancreas have been transplanted[9]. True, they began to transplant in our country. For the implementation of [kidney] transplants into practice, a group led by academician B.V. Petrovsky received the State Prize. A kidney is much more difficult, in terms of transplantation, than a heart. The heart consists of homogeneous muscle tissue, and there are nerve nodes. The kidney is a very difficult organ to transplant and survives much worse. But the kidney has been transplanted in more than 5,000 patients, and recently the success rate has been 80%. If one can transplant a kidney, then the one can transplant other organs.
>
> I have done many hundreds of experiments on transplanting an additional heart. I also performed operations on corpses to transplant an

[7] It could be seen that V.P. Demikhov was worried, naming the Central Committee of the CPSU instead of the Moscow Committee.

[8] In 1962, in the Botkin Hospital, V.P. Demikhov transplanted a kidney to the femoral vessels of a human. The operation was successful, but soon the kidney had to be removed.

[9] The list of organs does not include a heart, which transplantation began in 1967. V.P. Demikhov noted that he met Dr C. Barnard, the pioneer of heart transplant, only once, in 1960.

additional heart into a human [and came to the conclusion:] it is not necessary to remove an infarcted heart. [To do this], I made a retraction from the left ventricle so that the load was transferred to the additional heart. The operation is very simple and easy to perform. If clinicians wish, I will be happy to team up with the surgeons of the Institute. I have already agreed with military surgeons, but it would be much more pleasant for me to do it here, at the Institute where I work. <…>

On financing the problem of organ transplantation. Now [for us] this is problem number 1. The government has allocated 20 million rubles for this problem. A little bit of it is put on our laboratory. <…>

Two days ago (April 29, 1971 - *Auth*.) A thesis was defended from our Laboratory. New devices for suturing blood vessels have been created[10]. They are important for surgery. We have designed an even newer device[11]. If Gudov's device[12] costs 650 rubles, then ours of a higher quality in mass production will cost 65 kopecks. For the production of a sample device, mechanics from the Caliber plant spent 3 rubles. This is actually stitching tweezers.

Regarding transplantation. The whole world recognizes that the staff of the N.V. Sklifosovsky Institute includes the pioneers of transplantation and they are the founders of this science. B.V. Petrovsky, in his article published in one of the journals, considers transplantology to be “space in medicine”. <…>

According to our method, a doctoral thesis will be defended at the Institute of Tuberculosis, a thesis will be defended at the Academy of Medical Sciences. According to our method, a lot of dissertations like ours have been defended. In the Soviet Union and abroad[13]. <...>

I ask you to help me [with the financing of our work, with personnel and] with the implementation. I have developed an operation on the coronary vessels to prevent a heart attack. This operation began to be introduced into practice by V.I. Kolesov. He completed his doctoral thesis on this subject. <... >I am ready

[10] He meant the thesis of M.M. Razgulov and his device for suturing blood vessels.
[11] He meant the device for suturing blood vessels designed by V.P. Demikhov.
[12] He meant the vascular stapling device designed by V.F. Gudov.
[13] An interesting remark, since under the guidance of V.P. Demikhov, only two dissertations were defended: candidate and doctoral ones. Both, by M.M. Razgulov. Obviously, V.P. Demikhov “donated” the methods he developed to other dissertators, caring little about his scientific career.

to cooperate with all interested clinicians. I have developed a number of methods for bone grafting. Ready to cooperate with traumatologists" [9, p. 63–66].

Note that V.P. Demikhov was the only one of all the speakers who spoke to the pint: what he does, what he lacks, and what he needs in order to introduce the results of his research into clinic. He was supported by Doctor of Medical Sciences L.L. Gugushvili, the Senior Researcher of his Laboratory:

"I think," L.L. Gugushvili said, addressing the Director. − that V.P. Demikhov didn't do it out of malice[14]. He doesn't understand us a bit. Maybe it's my fault [that] we couldn't convince him that we weren't dangling specialists. We have the scientific side of the issue. We have done a lot scientifically. [Our employees] deal with circulatory pathology in emergency care and a number of other issues that are needed like air" [9, p. 68].

Then there were more speakers. One of the last to take the floor was A.P. Kuzmichev:

"In terms of speeches, our scientists really became more active <…>. All employees travel to all symposiums and conferences. We are very pleased that our employees were at the symposiums in Romania and Greece. The comrades went on scientific trips to the FRG. A group of comrades will soon go on a scientific trip to Yugoslavia. We will continue to participate in such conferences. Not so long ago, Professor Lebedev returned from a business trip to Germany. He reported a lot... I fully support, Boris Dmitrievich, your proposals: we need to create a program. You can't do it like this: "I want to do the right ear, and I want to do the left." We have a common direction. And here we must create a sound program for the five-year period. <…> Based on this program, it is possible to plan staffing and equipment" [9, p. 75–76].

[14] This refers to the conduct of unscheduled studies, for which B.D. Komarov criticized V.P. Demikhov.

The final word was taken by Professor B.D. Komarov. He spoke about the effectiveness of scientific work, about the prospects, and at the end he spoke about the speech of V.P. Demikhov:

"... We cannot limit ourselves to the work of a purely medical institution. We are expected both to restore the limb, and also to fully preserve its function. Therefore, we must ask questions that go beyond the mere joining of bones[15]. We must raise questions about restoring the vascular bed, about perfusion. But we must not break away from the tasks of practical public health. *We do not raise the issue of using heart-lung machine in the resuscitation system, since it is more convenient for us to do what we did earlier* (hereinafter, italics are ours - *Auth.*). <…> [Individualism] is not our task. Our task is to develop the problems that are set up for us. From this we will proceed, if we approach from the point of view of physical costs. Therefore, we are planning to employ economists who will begin to calculate the cost of work, including for experimental needs. <…>

Answering the 2nd question about the lack of funding for R&D, I must say what we lack. <...> Each leader should ask this question not in an indefinite form, that there is not enough finance, but to name how much we lack in rubles. No one will say, [because] no one knows how much something costs! In order to calculate this, one needs to introduce a system of planning and savings, then one can roughly name the specific numbers that are needed to conduct experimental research. <…> Why experimental? Because we have no shortage on the experiment. Therefore, it is necessary to decide on the items: equipment and devices, medical instruments, drugs going to the experiment. <…>

The question of staffing. There will be a competition, and we will say that staffing is complete in 1972. [As for the heads of departments], the administration requires some work from you, and as we saw from the discussion, demagoguery is still going on in our country. <...> The Executive Committee [of the Moscow City Council] wrote to us that we should not be scattered. *It is impossible to do what we are not supposed to do*.

[15] Apparently B.D. Komarov meant the method proposed by V.P. Demikhov for transplanting an arm with scapula.

As for organ and tissue transplantation, it must be said that without the development of these important issues of the Institute, we will not develop further. These are promising trends. <…> There can be no disagreement here. But *there is one complaint about the employees of this Laboratory*. Its Head seemed to take everything into his address. Nothing like this! Here, much depends on how the Laboratory staff understands the tasks. *This Laboratory should work according to the plan for the development of the emergency medical service, as determined by the Collegium of the USSR Ministry of Health, and other regulatory authorities. However, some employees feel they can work on their individual plan.* <…>

The head of the department has the right to raise the question that his employees work according to the plan according to which the administration proposes to work. What turns out with V.P. Demikhov? The Academic Council has the right to raise the issue of the implementation of scientific topics by its employees precisely in terms of assistance to V.P. Demikhov. <...> You, Comrade V.P. Demikhov, have vacancies, but not all employees work in the way you work. Let's help you. <...> Our task is to unite all efforts and direct them in the same direction. It is necessary to stop the disunity of scientific research. <…> Our expenses must be planned and consistent, and only then will we really fulfill the tasks set for us by the Executive Committee of the Moscow City Council" [9, p. 80–87].

Highlighting the issues of staffing, funding and disunity of research, the Director called on the Institute staff, in particular, the staff of the Organ Transplantation Laboratory "to join efforts and direct them in one direction." The issue of introducing the results of experiments on organ transplantation into practice was not raised. However, at the next Meeting of the Council, held on April 26, 1972, at which the report on the scientific work of the Institute for 1971 and the issues of integration were discussed, B.G. Zhilis, the Head of the Department of Anesthesiology and Intensive Care nevertheless mentioned that the Department he headed worked with the Laboratory of V.P. Demikhov on two topics [9, p. 120].

At this Council Meeting, A.P. Kuzmichev said about the work of V.P. Demikhov like this:

> "About the problem of Transplantation of organs and tissues. Anatomical, physiological and experimental studies are being conducted to prepare methods for organ transplantation. In particular, a new method of connecting vessels was developed (Thesis by M.M. Razgulov for the Candidate of Science Degree); an original method was proposed for implanting a second additional heart into the chest (without removing the native one), etc. Research on the problem is mainly exploratory in nature…" [9, p. 138].

In the Resolution of the Academic Council on the report, the following was written: 1. To approve the work of the N.V. Sklifosovsky Institute for 1971; 2. To avoid polytheism when planning R&D. Focus on the implementation of priority topics arising from the needs of practical healthcare; 3. Aimed at control of the research plan implementation, to practice the reports of the heads of departments on the state of scientific research at the Academic Council; 4. To focus on addressing topical issues of improving emergency care for the sick and injured; 5. To carry out systematic work on the implementation of scientific achievements of the Institute in practical healthcare [9, p. 149]. Note that the Resolution points 2, 4, and 5 directly related to the research of V.P. Demikhov: all his works had access to the clinic and were proposed for implementation in practical healthcare.

Another event characteristic of that time took place on May 24, 1972, when the Academic Council considered the issue of conferring the academic title "Professor" to Doctors of Science A.P. Kuzmichev, V.P. Demikhov, and P.N. Petrov.

Granting the titles sought to A.P. Kuzmichev and P.N. Petrov were resolved without debate and unanimously [9, p. 159-160, 163]. Regarding

the candidacy of V.P. Demikhov, a question was asked about the number of his trainees who defended their theses. However, after hearing the speeches of N.N. Kanshina, B.G. Zhilis, and B.D. Komarov in support of granting the desired title to V.P. Demikhov, the Academic Council held a vote, the results of which were as follows: 31 members of the Academic Council agreed with granting the title, and 2 voted against that.

Meanwhile, in protocol No. 8 of the Institute Academic Council Meeting dated October 25, 1972, we read: “Members of the Academic Council were present <…> Professor A.P. Kuzmichev, <…> Doctor of Biological Sciences V.P. Demikhov, <…> Professor P.N. Petrov” [9, p. 247] . Thus, despite the support of the Academic Council, V.P. Demikhov never got the title of "Professor". The Institute's submission for nomination was not approved by All-Union Attestation Commission.

On November 27, 1972, the N.V. Sklifosovsky Institute was assigned the 1st category with the appropriate staff and funding.

On December 13, 1972, the Academic Council listened to the report of A.P. Kuzmichev on the Institute Research Plan for 1973. The Report covered all topics except transplantology.

V.P. Demikhov, of course, spoke in the debate, but somehow hesitantly:

> “The Laboratory strives to conduct comprehensive research with other scientific departments of the Institute and other institutions. At present, we are ready to carry out developments on the cerebral cortex condition, in particular, on ischemic stroke. It is very difficult for the Laboratory to conduct scientific work, since it has only 3 researchers (L.L. Gugushvili, V.S. Nepomnyashchaya and V.M. Goryainov – *Auth.*), and even then L.L. Gugushvili deals with his particular subject. Contact is being established with the Ambulance Station for the use of equipment in the presence of severe heart failure ..." [9, p. 329].

On January 24, 1973, the Academic Council heard the report of Professor A.P. Kuzmichev "Report on research for 1972". The main subject of the report, as in 1971, was "the *further improvement of emergency medical care for the population in acute diseases and emergency conditions*." There were named the topics completed and incompleted. Topics on the problem "Development of methods that ensure effective transplantation of organs and tissues", which were developed by V.P. Demikhov, were declared transitional [10, p. 9–31].

In conclusion, Professor B.D. Komarov, the Director of the N.V. Sklifosovsky Institute, said that the Institute should use scientific equipment more intensively, involve all employees in scientific research and continue to integrate on the main topics [10, p. 32].

Recall, at that time the Laboratory headed by V.P. Demikhov had one electrocardiograph, 3 researchers, and he was ready to cooperate with all departments of the Institute.

Operations performed by V.P. Demikhov in 1971–1972

Note that much of what V.P. Demikhov was dealing with, did not fit into the research plans of the N.V. Sklifosovsky N.V. Sklifosovsky Institute. Below, there are listed the interventions performed in the Organ Transplantation Laboratory from January 1971 to December 1972 (Fig. 5), classified by types of operations (Table 1) [11].

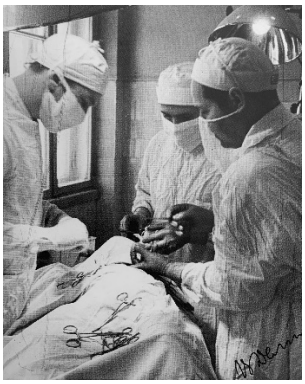

Fig. 5 .V.P. Demikhov (on the right) is operating. 1970s [1]

Table 1. Operations performed in the Organ Transplantation Laboratory of the N.V. Sklifosovsky Institute in 1971–1972

No.	Operation name	Qty	Dates
ISOLATED CARDIOPULMONARY COMPLEX TRANSPLANT			
1.	Transplantation (implanting) of CPC on the vessels of the neck	1	23.03.1971
2.	Transplantation (implanting) of CPC to the iliac vessels	2	26.05.1971–22.06.1971
3.	Orthotopic transplantation (replacement) of the cardiopulmonary complex (CPC)	3	01.06.1971
4.	Transplantation (implanting) of CPC into the abdominal cavity	1	08.02.1972
5.	Transplantation (implanting) of CPC on the femoral vessels	1	26.05.1971–22.06.1971
TOTAL:		**8**	**23.03.1971–08.02.1972**
ISOLATED HEART TRANSPLANT			
6.	Transplantation (implanting) of the heart on the iliac vessels	4	02.02.1971–25.01.1972
7.	Transplantation (implanting) of the heart on the vessels of the neck	2	16.03.1971; 18.03.1971
8.	Transplantation (implantation) of the heart into the abdominal cavity on the vessels of the kidney	1	15.12.1971
9.	Transplantation (implantation) of the 2nd heart into the chest on a human corpse	1	20.12.1971
10.	Transplantation of an additional heart into the chest cavity	1	14.03.1972
TOTAL:		**9**	**02.02.1971–14.03.1972**
REVITALIZATION OF THE CARDIOPULMONARY COMPLEX AND THE HUMAN HEART			
11.	Revitalization of the cardio-pulmonary complex by connecting it to the vessels of a pig	1	22.05.1971
12.	**Revitalization of the human heart**		
A)	Revitalization of the human heart at 1 hour 30 minutes and 1 hour 40 minutes after death	2	03.06.1971; 07.01.1972
B)	Revitalization of the heart of a 70-year-old human at 2 hours after death	1	07.06.1971
C)	Revitalization of a 24-year-old human heart by connecting it to the femoral artery of a pig 2 at hours 24 minutes after death	1	18.06.1971
D)	Revitalization of the human heart at 3 (2 cases) and 8 hours after death	3	08.07.1971; 31.07.1971; 19.01.1972
E)	Revitalization of a human heart by connecting it to the femoral artery of a pig	1	14.09.1971
F)	Revitalization of the human heart by massage at 4 hours 45 minutes after death	1	28.12.1971
G)	Revitalization of a human heart by connecting it to the femoral artery of a pig at 4 and 6 hours	2	04.01.1972; 13.01.1972

	after death		
H)	Revitalization of a human heart by connecting it to the femoral artery of a pig at 6 hours after death	1	13.01.1972
I)	Revitalization of the woman corpse heart with a massage	1	07.06.1972
TOTAL:		**14**	**22.05.1971–07.06.1972**
MECHANICAL CIRCULATION			
13.	Testing HLM designed by Korolev	4	12.04.1971–17.10.1971
TOTAL:		**4**	**12.04.1971–17.10.1971**
CONNECTING THE BODY HALVES			
14.	Joining the body halves	10	07.01.1971–11.05.1972
15.	Connecting the body halves. Implantation of the liver and kidneys to the iliac vessels	1	24.02.1971
16.	Implantation of the anterior half of the body (head with an intact chest and adrenal glands) to the iliac vessels	1	21.04.1971
17.	Connecting the body halves. Removal of the liver from the recipient	1	02.09.1971
TOTAL:		**13**	**07.01.1971–02.09.1971**
OPERATIONS ON THE ABDOMINAL CAVITY			
18.	Transplantation of the hepatica-renal complex to the femoral vessels	1	14.06.1971
TOTAL:		**1**	**14.06.1971**
EXCHANGE BLOOD TRANSFUSION			
19.	Exchange transfusion of human cadaveric blood to a dog	9	25.02.1972–26.10.72
TOTAL:		**9**	**25.02.1972–26.10.72**
VASCULAR SURGERY			
20.	Testing the vascular suture device designed by M.M. Razgulov	1	08.01.1971
21.	Isolation of the carotid artery	1	03.05.1971
22.	Creation of an arterial shunt in a dog (the end of the renal artery after the kidney removal to the side of the abdominal aorta)	1	20.10.1971
23.	Scribner shunt making[16] (left femoral artery and left femoral vein)	2	21.10.1971; 27.10.1971
24.	Making the Scribner shunt on the carotid artery and jugular vein	1	03.10.1972
TOTAL:		**6**	**08.01.1971–03.10.1972**
OPERATIONS ON THE SPINAL CORD			
25.	Stitching the spinal cord roots. Development of the technique (M.M. Razgulov)	1	22.06.1971
26.	Modeling of traumatic brain injury. Stitching the	1	17.11.1971

[16] An external arteriovenous shunt is a type of temporary vascular access. For implantation of the shunt, arterio- and venotomy is performed, the vessels are cannulated, the internal parts of the shunt are placed in the subcutaneous tunnels and brought out through additional incisions. The shunt consists of two silicone tubes that are put on cannulas. The ends of the shunt are connected with a silicone tube.

	spinal cord roots. Development of the technique (M.M. Razgulov)		
27.	Transection of the spinal cord (Orlov)	1	15.05.1972
TOTAL:		**3**	**22.06.1971–15.05.1972**
EXPERIMENTS IN CIRCULATION PHYSIOLOGY			
28.	Measurement and recording of intraventricular pressure. Development of the technique	1	??.03.1971
29.	Pressure Measurement of and the study of retrograde circulation in 2 dogs (L.L. Gugushvili, V.S. Nepomnyashchaya)	1	31.03.1971
TOTAL:		**2**	**March 1971**
LIMB HOMOTRANSPLANTATION			
30.	Replacement of the right forelimb in a dog	2	24.06.1971; 25.11.1971
31.	Replacement of the left forelimb in a dog	4	01.07.1971–07.12.1971
32.	Left hind limb replacement	1	06.07.1971
TOTAL:		**7**	**24.06.1971–06.07.1971**

In total, from January 7, 1971 to December 30, 1972, V.P. Demikhov, his staff and students performed 76 operations of 11 types (Table 2).

Table 2. Total number of operations performed by V.P. Demikhov in 1971–1972

No.	Name of operation	Qty (% of total)
1.	Revitalization of the cardiopulmonary complex and the heart	14
2.	Connecting the body halves	13
3.	Isolated heart transplant	9
4.	Exchange transfusion	9
5.	Transplantation of an isolated cardiopulmonary complex	8
6.	Limb homotransplantation	7
7.	Operations on vessels	6
8.	Cardiopulmonary bypass	4
9.	Operations on the spinal cord	3
10.	Experiments on the physiology of blood circulation	2
11.	Operations on the abdominal organs	1
TOTAL:		**76**

When comparing the types of operations performed in 1970–1972 with those performed in 1969–1970, it is noteworthy mentioning that 4 types of operations were still “leading”: revitalization of the cardiopulmonary complex (14 operations), exchange blood transfusion needed for the development of resuscitation techniques (9 transfusions),

transplantation of an isolated heart (9 operations), and transplantation of the cardiopulmonary complex (8 interventions). Together, these 4 interventions account for 52.6% of all operations, that is, more than half. The number of experiments with heart-lung machine also doubled.

All this may indicate that V.P. Demikhov did not leave his desire to transplant a revitalized heart or a cardiopulmonary complex in clinic. Note, however, that the delivery time of the deceased to the Organ Transplantation Laboratory for resuscitation was too long: 1 hour 30 minutes, 1 hour 40 minutes, 2 hours, 2 hours 24 minutes, 3 hours, 8 hours, 4 hours 45 minutes, 6 hours. It is hard to believe that, on the one hand, V.P. Demikhov was not familiar with the works of V.A. Negovsky about clinical death. But, on the other hand, he was inspired by the experiments of A.A. Kulyabko of the early twentieth century, which revitalized the human heart 20 hours after it arrested, and by the experiments of S.S. Bryukhonenko on revitalizing the heart and the whole body of a dog performed in the late 1930s. "*Isolated organs can be revitalized even if they are taken from the corpse of an animal some time after death,*" wrote S.S. Bryukhonenko in 1940 in the script for the popular science film "Experiments in the Revitalization of the Organism". - *To do this, blood is passed through the vessels of the heart (Fig. 6). The isolated heart beats just as it did in the body of a living dog a few hours before*." Following the experiments on revitalizing the heart, the experiments on revitalizing the lung, the dog's head, and the whole organism were demonstrated in this film [12].

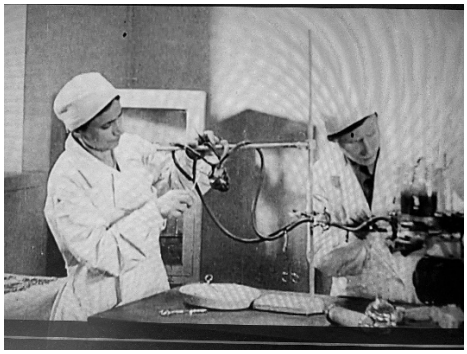

Fig. 6. Experiments with revitalizing an isolated heart by perfusion of the coronary arteries with oxygenated blood using the cardiopulmonary bypass according to S.S. Bryukhonenko. 1940 [12]

However, none of 13 attempts to revive the heart was successful (Table 1). Note that in 11 cases after thoracotomy, it was found that the heart was not suitable for resuscitation (Table 3).

The number of surgeries to connect the halves of the body increased to 13 (17.1%) versus 11 (12.6%) over the previous 4 years. It is not clear why V.P. Demikhov conducted these experiments. However, in 1971-1972, not a single operation of head transplantation was done, not a single intervention on the urogenital organs or on the hematopoietic organs. But there were new experiments on homotransplantation of limbs, on the spinal cord, on the physiology of blood circulation.

Again, as in the previous article, we note a clear discrepancy in the number of operations listed in the "List of experiments made in the Organ Transplantation Laboratory of the N.V. Sklifosovsky N.V. Sklifosovsky Research Institute for Emergency Medicine for the period from 1960 to 1984" [12] and the number of experiments reported in the R&D Reporting Cards. So, for example, in Reporting Sheet No. 43 on the topic "A new method for connecting blood vessels with metal clips and its experimental substantiation" it is said that there were 43 experiments performed on 41 dogs during a year [6, p. 147]. Meanwhile, in the "List of experiments" such an operation was only one. Considering that

M.M. Razgulov, the investigator on the topic research worked in another institution, one can assume that he conducted his experiments there. Unfortunately, we could not trace the research performed by V.P. Demikhov in 1972, using the Reporting Sheets, due to the absence of such in the documents of the Academic Council of the N.V. Sklifosovsky Institute for that year.

Two years earlier, even more unperformed operations turned to be in 1971–1972: 18 versus 5 (Table 3). It should be noted that 13 of 18 unperformed interventions had to be related to the revitalization of human heart, and they were not performed due heart unsuitability for resuscitation.

Table 3. Operations not performed in 1971–1972

No.	Operation name	Qty	Year
1.	Front leg replacement. Operation was not performed	2	13.07.1971; 01.02.1972
2.	Connecting the body halves. Operation was not performed	2	01.06.1972; 04.05.1972
3.	The dog was given morphine. Operation was not performed	1	14.06.1972
4.	The operation of transplanting the front leg with a scapula in a dog has not been completed	1	23.09.1971
5.	Two human corpses were brought to the Laboratory for resuscitation. Thoracotomy. Hearts did not fit for revitalization	2	25.10.1971
6.	11 human corpses were brought to the laboratory for resuscitation. Thoracotomy. Hearts are not suitable for revitalization	11	30.12.1971–20.04.1972
TOTAL:		**18**	**13.07.1971–04.05.1972**

Conclusion

In 1971–1972, V.P. Demikhov continued to make the research, which results, as he believed, could be introduced into practical healthcare. In 1971, together with M.M. Razgulov, he proposed a new method of connecting blood vessels, a new method of transplanting the

upper limb together with a scapula, repeated the experiments, previously made on dogs, on human corpses (revitalization of a cadaveric heart, monitoring its activity using an ECG, implanting an additional heart into the chest of a corpse aimed at implementing the method into clinic for the treatment of heart failure), presented the results of his research at the X International Congress on Cardiovascular Diseases. In 1971–1972 V.P. Demikhov performed 76 experimental interventions of 11 types, most of which were aimed at developing the techniques for transplanting an isolated cardiopulmonary complex and an isolated heart, as well as a method for their revitalization. It should be noted that all the methods of organ transplantation developed by him were intended for implementation in clinic. However, no method was introduced in clinic during that period of time.

Moreover, in 1972 he was accused of individualism, that he was conducting his research, mostly exploratory ones, according to his personal rather that the Institute plan. In part, that accusation was fair, because, as the review of the documents showed, not all of V.P. Demikhov's experiments were indicated in R&D Sheets.

But the point here, in our opinion, was not at all the unwillingness of the N.V. Sklifosovsky Institute Administration to implement the methods he developed on animals into practical public health. The fact is that in the early 1970s, the research conducted by V.P. Demikhov could not be adequately provided logistically or economically because his research ceased to correspond to the main task of the Institute's activity, that is to improve the organizing system for rendering an emergency care to the Moscow population with acute diseases and injuries.

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