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History in Cardiology

Vasilii I Kolesov: The First Series of Best Option Coronary Bypass Pioneer

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Abstract:

Heart surgery is one of the areas of greatest achievement in 20th century medical science. As the number one killer, Ischemic heart disease (IHD) was a big hurdle in achieving health for all. In this century, cardiovascular scientists put effort to combat the disease. Vasilii Ivanovich Kolesov is the early and successful contributor among them in the field of coronary surgery. On 25 February 1964, V.I. Kolesov successfully performed the first anastomosis between the left internal thoracic artery and the left circumflex artery. This was the beginning of a new era of coronary bypass surgeries, carried out on a regular basis to re-establish coronary flow in patients with IHD. This operation, in combination with Rene G. Favaloro's method of using the saphenous vein in coronary surgery become the most commonly performed surgical procedure in the world.

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Introduction:

Coronary artery disease is a common and deadly medical condition management of which was challenging for the physicians and surgeons. Originally, the only option was to modify or palliate this condition. Early operations were designed to stimulate intercoronary communication by producing neoangiogenesis via a granulomatous response in the pericardium and epicardium. To achieve the goal, powdered asbestos, talc, silica, or phenol was insufflated into the pericardial space. Other approaches included abrading the epicardium, ligating the internal mammary artery or coronary vein, arterializing the coronary sinus, or grafting vascular tissue into the epicardium.[1]

Fig-1: *Faculty Surgery Clinic of Leningrad Medical Institute in 1904.*

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Academician I.P. Pavlov Leningrad Medical Institute (Fig-1) already had an experience of indirect myocardial revascularization. Over 300 patients were operated on using the Fieschi operation technique (ITA ligature), and over 20 using Vineberg operation -based surgeries (ITA implantation into the myocardium). However, many surgeons were not satisfied with indirect myocardial revascularization, and many different laboratories worldwide were getting ready for the development of the direct approach. V.I. Kolesov conducted experiments on animals to create a highly efficient anastomosis between ITA and coronary arteries, prior to its clinical performance.[2]

Early life and education:

Dr. V.I. Kolesov was born on 24 September 1904 in the village of Martemianovskaya in the Vologda Region. His parents were well to do farmers, Maria K. and Ivan N. Kolesov. He had 3 brothers and 2 sisters.[2] Kolesov left home to study medicine in Leningrad, the present-day city of St. Petersburg, where Kolesov studied and worked. In 1927, he was admitted to the State Institute of Medical Knowledge, Leningrad Medical Institute (current name: I.I. Mechnikov North-West University) and completed the medical programme in 1931. V.I. Kolesov showed an interest in research and joined the biology society in his student years guided by Pyotr Pavlovich Ivanov. In 1931, the young doctor V.I. Kolesov was assigned to work in the local hospital in the village of Chusovaya in the Perm territory located in the northern part of the Ural Mountains. Here Kolesov met his wife to be, Ettel I. Kerstein, who was a recent medical graduate working in obstetrics and gynecology. During this time, his parents endured forced "collectivization", lost their farm, and were obliged to move to Chusovaya, where they shared the young couple's home. Kolesov's son Evgenii was born on the 15th June 1935.

In 1934, V.I. Kolesov was admitted to work in the surgery ward of the clinic at the Perm Medical Institute as an attending doctor under Vasilii Nikolaevich Parin, an intelligent and enthusiastic scientist in charge of the ward. In 1938, he received his Master degree in surgery from the Leningrad Institute of Postgraduate Medical Studies, shortly after he successfully defended his thesis 'On eventration of spleen into the abdominal wound'.[2]

World War II:

In 1941, during the World War II, V.I. Kolesov kept working as a surgeon in Leningrad. On 22nd June 1941, Hitler's Germany invaded Soviet Union. Following German invasion, he was given the rank of major in the Medical Corps of the Army and was appointed surgeon-in-chief to one of the municipal hospitals. The hospital was in the heart of the city, in the spacious building of the former German embassy. Operation Barbarossa, the German attack on the Eastern front initially was very successful and Nazi troops were rapidly approaching Leningrad, then a city of 3 million people. An emergency evacuation of the civilian population began. Kolesov's wife and son were able to escape to Chusovaya just a few days before the siege of the city.

The location of Leningrad is in a strategically awkward location just next to the border of Finland, a German ally. The city was surrounded by German troops shutting off rest of the country. The siege of the city began. By the time, the Nazis occupied almost all of Europe. France withstand the Nazis for only 42 days before surrendering but people of Leningrad never surrendered despite starvation, cold and almost daily bombardments for 872 days. Kolesov was one of them and sharing a room with his brother in the basement of his hospital. Their sister Polina and 2 of her children did not escape and remained in the besieged city as well. Nazi troops occupied St. Isaac's Cathedral and the Russian air force was almost completely destroyed during the first months of the war. To protect Kolesov's hospital and central part of the city, defenders deployed giant barrage balloons during the raids by German planes. Kolesov and his coworkers took chances to perform emergency surgery and elective surgery at night. Once during a surgery, a bomb exploded near window and a fragment of shell flew above the operating table, missing Kolesov's head by only a few inches. Another fragment stroked the ceiling, sending dust to open wound and Kolesov was to lean over the wound and rubble fell on his back instead. In December 1941, situation became more desperate and in January 1942, in the depth of cold winter, the city's daily rations reached an all-time low of only 150 gm of bread. In just two months, January

and February 1942, 200,000 people died in Leningrad of cold and starvation. The rations at the hospital hardly sufficient for normal wound healing. Wounds took months to heal and Kolesov tried to prevent infection by maintaining pristine cleanliness in the operating room and by thorough hand washing and often lacking antibiotics. Using bacteriophages, Kolesov managed to clean many infected wounds. Kolesov and his brother Nikolai always saved rations for their sister Polina and her children. As the siege continued, Nikolai became too weak to move and finally died despite Vasilii's care. Kolesov's health condition was also deteriorating due to pericardial effusion during the siege, so that he was barely able to walk a few steps before developing shortness of breath. In a few days he felt somewhat better and returned to service as a senior surgeon, working in the military evacuation hospital, right after his recovery. Kolesov lost contact with his sister during this time but when he rushed to see her knew that his nephew and niece had died of starvation. On 27 January 1944, the siege ended and Kolesov reunited with his wife and son Evgenii Kolesov.[3]

After the war in 1946, Kolesov received an employment offer from Pyotr Andreevich Kuprianov, who had been appointed head of the 2nd Faculty Surgery Clinic of the Military Medical Academy in 1945. V.I. Kolesov defended his doctorate dissertation on bacteriological control and septic wound treatment with bacteriophage in 1946 and then left for Austria on a long term business mission to be in charge of the surgery service of the advancing Central Army Group in 1949. Then, he was appointed chief of the battle field surgery department in Kharkov (Ukraine), from where he moved back to Leningrad to lead the general surgery department. In 1953, he left the military service with the rank of colonel of the Medical Corps and became head of the Faculty Surgery Clinic of the Academician I.P. Pavlov Leningrad Medical Institute. It was here that V.I. Kolesov's teaching and research talents became obvious and he performed the first coronary bypass operation, which made it possible to refer to V.I. Kolesov as the coronary surgery pioneer.[3,4,5]

Surgical Career in Coronary Bypass:

V.I. Kolesov was a man of broad scientific vision and interest. He displayed an extensive knowledge and his contributions in surgical research were presented at symposiums, conferences, congresses and meetings of the Pirogov Surgical Society. In 1955, his major clinical focus was on myocardial blood flow and surgical treatment of coronary artery disease. V.I. Kolesov studied all available USSR and foreign language publications. And later in 1966, he published in detail a book on the history of ischemic heart disease and surgical treatment targeting indirect myocardial revascularization. Studies of the coronary flow and its surgical correction started at the time of his work in Faculty Surgery Clinic. And he was then head of the clinic that was one of the major surgical clinics in the Soviet Union.[6,7]

Fig-2: *Visilii I Kolesov in 1966.*

Dr V.I. Kolesov by 1966 (Fig-2), did the Fieschi operation, which was popular in the 1950s, was performed on 310 patients.[8] Another procedure, which was presented by the Canadian surgeon Arthur Vineberg in 1946, was applied in 21 patients by Dr Kolesov. Most of these patients were claimed to have positive outcomes.[9] Dr Kolesov then focused on the work of those experimentalists who made most significant contributions to the development of coronary blood flow re-establishment using internal thoracic artery. In 1953, Vladimir P Demikhov in Moscow and Gordon Murrey in Canada independently of each demonstrated anastomosis between ITA and the coronary artery in dogs using Payr's cannula and non-suture technique. They laid the

foundation of coronary flow re-establishment using systemic arteries experimentally in dogs.[10,11]

On May 2, 1960, Robert H. Goetz in New York was the first one to anastomose ITA and the right coronary artery (RCA) in a patient using tantalum rings. He reported this surgery in 1961 in an addendum to an article describing experiments on dogs, which he carried out in the late 1950s. As a result of harsh criticism from his colleagues, R.H. Goetz never performed such an operation again.[1,12]

In 1963, Kolesov became aware of successful experiment by Pronin, who used a collapsible cannula in dogs to provide continuous blood flow into a coronary artery while the suture anastomosis was created. Kolesov successfully tried this technique in dogs and constructed an instrument for application of the principle of continuous coronary auto perfusion. And able to create an anastomosis between ITA and a coronary artery without interruption of coronary blood flow. Eight dogs underwent follow-up for as long as 19 months, and the patency of anastomosis was demonstrated in all animals.[13]

A large scale experiments by V.I. Kolesov made it possible to clinically perform mammary-coronary bypass and of course gave credit to Demikhov, Murray, Goetz, and Pronin, the predecessors. Out of two ITA-CABG anastomosis techniques (non-suture and suture), V.I. Kolesov focused on the later, trying to create a T-shaped anastomosis for clinical practice. On 25 February 1964, the CABG operation was first performed by V.I. Kolesov. He approached through left thoracotomy in the 5th intercostal space and the patient was on right lateral position. ITA mobilized together with adjacent tissues. He found calcification in the initial parts of the anterior interventricular and circumflex branches of left coronary artery. The calcified part of circumflex artery was chosen and tourniquet placed for 8 minutes but heart function did not change and arterial pressure remain stable. ECG showed no change during the period, so conclusion was made that permanent impairment of blood flow in the selected artery and it was possible to open it without causing fibrillation of ventricles. The patency of the peripheral part ensured, central blood flow interrupted and end-to-end anastomosis created with the help of a magnifying glass using suture technique. Pulsation distal to anastomosis restarted. And the era of modern coronary surgery had begun. Pericardium closed then closed the thoracotomy wound completely. Postoperative period was without complications. The patient showed no symptoms of ischemia and was followed up for several years.[2,14]

Anxiety of new procedure creates resistance:

Although the early results were encouraging, but were not accepted easily. There were lots of resistance. Such attitude was not unique to Kolesov's work, Drs Robert H. Goetz and Rene' G. Favaloro and even the father of aseptic surgery Joseph Lister also faced criticism from more conservative colleagues. When Kolesov's initial experience was published, it was accompanied by the following editorial comment: "The opinions concerning the management and surgical treatment of angina pectoris by Professor V.I. Kolesov are at variance with the concepts of many surgeons in USA.[15] Unfortunately, the reaction was even worse in his home country. When placed in a meeting, the Cardiology Society of Leningrad accepted the resolution: "the surgical treatment of coronary artery disease is impossible and has no prospects in the future."[16]

Kolesov appreciated the importance of coronary angiography. By the late 1960s, most CABG patients underwent preoperative coronary angiography and subsequently underwent long-term evaluation of the anastomoses.[17]

Kolesov advocated the use of off-pump CABG. In the early 1960s, Kolesov conducted a study of artificial circulation and concluded that while cardiopulmonary bypass is safe and reliable for use during open heart surgery, the global inflammatory response following the extracorporeal circulation is too great to justify its use for CABG.[18] By the end of 1960s, extracorporeal circulation established in Kolesov's clinic and routinely used for intracardiac correction of congenital heart defects and valvular surgery. Kolesov continued to perform CABG in beating heart and believing its superiority. Only 18% of his CABG procedures were done on-pump between 1964 and 1974.

Kolesov's team was the first and remains the only to use coronary stapling clinically. After several modifications, VCA-4 (vascular circular stapling apparatus-4) was first applied clinically on 22 March 1967 and constructed end-to-end anastomosis between the LIMA and the left anterior descending coronary artery in a 52 years old man with class IV angina pectoris that remained pain free three years.[19]

On 9 May 1967, Rene' G. Favaloro at the Cleveland Clinic performed the first documented CABG with saphenous vein graft. Donald B. Effler, head of cardiothoracic surgery of Cleveland Clinic and colleagues reporting in April 1971 on CABG with SVGs, mentioned the work of Kolesov on the ITA and commented: "This is an interesting and practical possibility, and it has been used to a very limited degree by the Cleveland Clinic team. This can be a useful revascularization tool in carefully selected cases, but it hardly constitutes simple surgery." For a few years, the explosive development and success of Cleveland Clinic team, overshadowed Kolesov's initial work on the ITA graft.[1,20] Kolesov continued to believe in the advantages of all-arterial CABG and explored the possibility of using the arteries of the abdominal cavity as bypass conduits. It was only during the mid-1980s that the advantages of arterial grafts in terms of superior long-term patency was first appreciated. Kolesov diligently continued his work, remaining a compassionate physician and an enthusiastic research scientist. There were two striking features about Kolesov. First, Kolesov always took time to listen to what his patients had to say, despite being very busy. Second, Kolesov took extra-long time to wash his hands meticulously, a habit he had acquired during the war. The progress made by Kolesov's team in the 1960s drew international attention to see Kolesov's department from 1965 to 1975, including Drs. Earl B. Kay, Rene G. Favaloro, Denton A. Cooley, Vincent M. Dor, Gordon K. Danielson, and Joseph J. Verska. However, the full significance of Kolesov's innovations was yet to be appreciated.[1]

In the late 1970s, Kolesov's reported angiographic evaluations of CABG demonstrated an excellent patency rate and functional results. After his retirement in 1976, he continued his long-term follow-up studies, lectured to medical students and enjoyed going for long walks with his dog and meeting with friends. In the mid-1980s superiority of Internal Mammary grafts for long-term patency rate and improved survival over SVGs were demonstrated. In 1988, Effler wrote: "In retrospect, some might say that the Kolesov team in Leningrad acted prematurely because surgical treatment preceded accurate diagnosis (coronary arteriography). In my opinion, this is not the case. The Kolesov saga deserves the recognition of all who are interested in surgical treatment of coronary artery disease.[21] Kolesov remained active and published his last paper 1 year before his death. Kolesov breathed his last on 2 August 1992.

Conclusion:

Kolesov thought that arterial grafts are superior to that of venous grafts. The internal thoracic artery is the graft of choice. Off-pump coronary artery bypass surgery (OPCAB) has important advantages over the on-pump procedure. Kolesov did direct end to end coronary-mammary anastomosis by stapling and rapid advances in robotic surgery have grown interest in it. And all of these have done by Kolesov 56 years back before the rest of the world. Kolesov was one the few, who have greatest service to humanity. Kolesov started the era of modern coronary surgery and his contributions to the field cannot be overemphasized.

Conflict of Interest - None.

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