A Tribute to Dr. Fedor A. Serbinenko, Founder of Endovascular Neurosurgery

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FROM HUMBLE BEGINNINGS in the former Soviet Union, Fedor A. Serbinenko, M.D., Ph.D., became a leading figure at Moscow's famed Burdenko Neurosurgery Institute. While there, he invented and perfected the technique of balloon embolization, which was destined to change the practice of neurovascular surgery forever. We present the life and achievements of the father of endovascular neurosurgery. (Neurosurgery 46:462-470, 2000)

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It is difficult to imagine the practice of modern neurovascular surgery without the collaboration and assistance of interventional neuroradiology, also known as endovascular neurosurgery. The management of complex central nervous system arteriovenous malformations (AVMs), dural arteriovenous fistulae (AVFs), vascular head, neck, and spinal tumors, intracranial aneurysms, postsubarachnoid hemorrhage vasospasm, carotid-cavernous fistulae (CCFs), acute stroke, and even carotid stenoses is increasingly the responsibility of the new breed of physician known as the neurointerventionalist.

Equally as impressive as the variety of diseases now treated by neurointerventionalists are the endovascular tools currently at their disposal. From braided hydrophilic catheters to aneurysm coils with new and complex shapes to vascular stents suitable for intracranial applications, these modern devices are a wonder of advanced engineering techniques combined with human ingenuity. Just 5 or 6 years ago, however, many of today's neurointerventional devices were either nonexistent or in a developmental stage. Just 10 years ago, detachable aneurysm coils did not exist, and the choice of available guidewires and catheters for neurointerventional work was extremely limited. Endovascular stents for peripheral and coronary procedures were still in clinical trials. Twenty years ago, only a few physicians worldwide performed neurointerventional procedures. Before the advent of magnetic resonance scanners and with only crude computed tomography, they used rudimentary catheter and embolic agent technology guided by primitive predigital era imaging systems. Today, one can only imagine the frustrations these trailblazers must have faced. Now, consider the enormous difficulties and challenges confronting a pioneering neurosurgeon struggling to develop novel catheter-based therapies for neurovascular diseases more than 30 years ago in Soviet Russia. This pioneer was Fedor Serbinenko (*Fig.* 1).

SERBINENKO'S CHILDHOOD AND EDUCATION

Fedor Andreevitch Serbinenko was born May 24, 1928, in the small village of Dmitriovsk in the Stavropol region of Northern Caucasus, in what was then the Soviet Union (*Fig. 2*). When he was a small boy, Serbinenko's family moved to Mineralnye Vody City, Northern Caucasus, where his father, Andrey, worked as a mechanic in the local flour mill, and his mother, Anastasia, was a homemaker (*Fig.* 3). His middle school studies were interrupted by World War II (the Great Patriotic War), during which his older brother, Yuri, was killed. His father, also a soldier, survived the war. To support his mother and grandmother during the conflict years of 1941 to 1945, young Serbinenko went to work at age 14 as an apprentice machinist. After the war, he continued working as a machinist but also studied at night; he completed secondary school with honors in 1948. He was then admitted to the I.M. Sechenov First

FIGURE 1. Professor Fedor A. Serbinenko, M.D., Ph.D., in 1998 at age 70.

Moscow Medical Institute, where he was an enthusiastic scholar and athlete excelling in volleyball, swimming, and ice skating. Economic hard times in postwar Russia compelled Serbinenko to work frequently at extracurricular jobs involving difficult physical labor. Despite this, he maintained a perfect medical school attendance record. By his third year of medical school, he was interested in scientific research involving surgery, pharmacology, and urology.

When he graduated from medical school in 1954, he received an appointment as an Academy of Medical Sciences intern at the N.N. Burdenko Neurosurgery Institute in Moscow' (19), where he has worked continuously for the past 44 years. At the time of Serbinenko's arrival, the Burdenko Institute was renowned as the Soviet Union's preeminent center for the neurosciences. It soon became apparent that Serbinenko had superior innate technical and intellectual skills that afforded him the potential of an outstanding surgical career. This was immediately recognized by his mentors. Professors A. Shlykov and M.A. Salazkin, two of the leading Soviet neurosurgeons of the day. They encouraged Serbinenko to become involved with percutaneous cerebral angiography, which at that time was performed by direct carotid and vertebral artery puncture. Serbinenko soon became an expert in this technique, leading to his interest in neurovascular pathology.

In 1957, Serbinenko became a neurosciences doctoral candidate. A portion of his thesis was devoted to the study of the pathophysiology and clinical manifestations of CCFs. He proposed a new classification system for CCFs based on their influence on cerebral circulation. This work stirred his imagination in the quest for alternative treatment options for patients with these fistulae, rather than the accepted intra- and extracranial surgical procedures of the time.

A CHANCE OBSERVATION RESULTS IN THE BIRTH OF AN IDEA

In 1959, at May Day celebrations in Moscow's Red Square, Serbinenko's attention was attracted to helium-filled balloons held by children. He noticed how these balloons were easily maneuvered by simple manipulations of their tether lines. He began to wonder whether a tiny balloon at the end of a long catheter could be similarly maneuvered and navigated intravascularly for diagnostic or therapeutic blockade of a vessel. The wheels had been set in motion.

FIGURE 2. Serbinenko in 1930 at age 2, in the village of Dmitriovsk, Northern Caucasus.

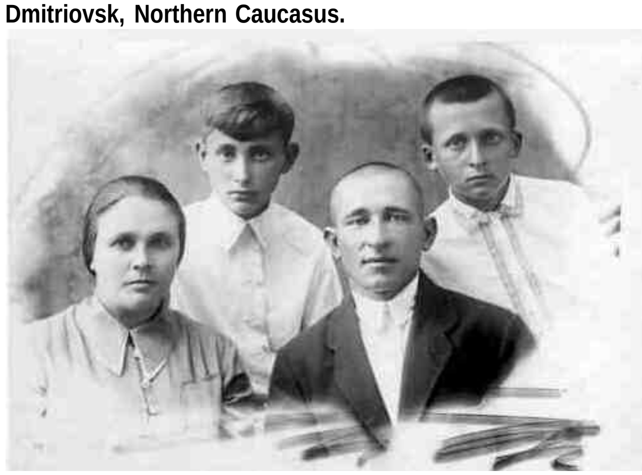


FIGURE 3. Serbinenko's family in 1941. *From left,* Serbinenko's mother, Anastasia Gavrilovna; Fedor Serbinenko; his father, Andrey Fedorovich; and his brother, Yuri.

Serbinenko soon organized a small laboratory to investigate potential materials for the creation of such a balloon catheter. He examined balloon materials including polyvinyl chloride, polyethylene, nylon materials, silicone, and latex. After much trial and error, he created prototype silicone and latex balloon catheters. Multiple benchtop and clinical failures during the next 9 years prompted repeated refinements in his design.

It soon became apparent that, with an improved design and with careful balloon inflation and deflation, the balloon-tipped microcatheter had excellent flow directional capabilities that allowed navigation of the tortuous vascular anatomy at the cranial base. This made possible the first effective intracranial catheterization. These same flow directional characteristics also allowed the balloon tip to preferentially seek out high-flow arteriovenous fistulae and major AVM feeding arteries. With the use of multiple balloon devices, superselective intracranial catheterization became possible. For example, with temporary balloon occlusion of the proximal middle cerebral artery, a second balloon could be flow directed into the ipsilateral anterior cerebral artery. A very powerful new medical tool had been created.

The first balloon catheters had permanently attached balloons and diameters of less than 1 mm. These devices were introduced through needles inserted directly into the cervical carotid artery. On February 8, 1964, the first selective external carotid angiogram was performed with the assistance of temporary internal carotid balloon occlusion (28). Thereafter, temporary balloon occlusion became an important adjunct to direct puncture carotid angiography at the Burdenko Institute. Two types of balloon devices came into use: a non-endhole device used only to occlude vessels, and a balloon catheter that not only created occlusion but also allowed passage of liquids though a separate lumen either distal or proximal to the balloon *(Fig. 4).* This device was the forerunner of the calibrated leak balloon catheter. The most important initial use of Serbinenko's invention was temporary diagnostic occlusion of major cerebral arteries. From 1969 to 1972, Serbinenko performed 304 such procedures with only two deaths (28).

Permanent therapeutic occlusion of cervical and intracranial arteries and vascular lesions was accomplished using a non-endhole balloon device. This device was inflated at a target site with a mixture of silicone polymer and tantalum powder to create a radiopaque material that would quickly become a stable gel within the balloon and distal catheter lumen. This allowed the catheter to be severed by the cutting edge of the arterial introduction needle without risking polymer leakage from the distal catheter segment (still attached to the inflated balloon), which was left in place intra-arterially *(Fig. 5).* The first such reported vessel occlusion was performed on April 24, 1970 (28), to sacrifice an internal carotid artery and treat CCF. (Serbinenko later claimed, however, that his first successful balloon embolization was accomplished on December 15, 1969 [29].)

Unfortunately, silicone polymer proved to be highly viscous, at times preventing balloon deflation if device placement was suboptimal. The technique was improved by inflating the balloon initially with less viscous iodinated contrast material to determine whether the position of the balloon in a target vessel or lesion was satisfactory. Once correct placement was confirmed, the contrast material was aspirated and silicone polymer was injected into the balloon.

Serbinenko subsequently developed a balloon with an ingenious valve mechanism that allowed balloon detachment from its delivery microcatheter by placing traction on the catheter *(Fig. 6).* This modification eliminated the attached distal catheter segment used in the earlier deployment system. From 1970 to 1973, Serbinenko performed 162 permanent

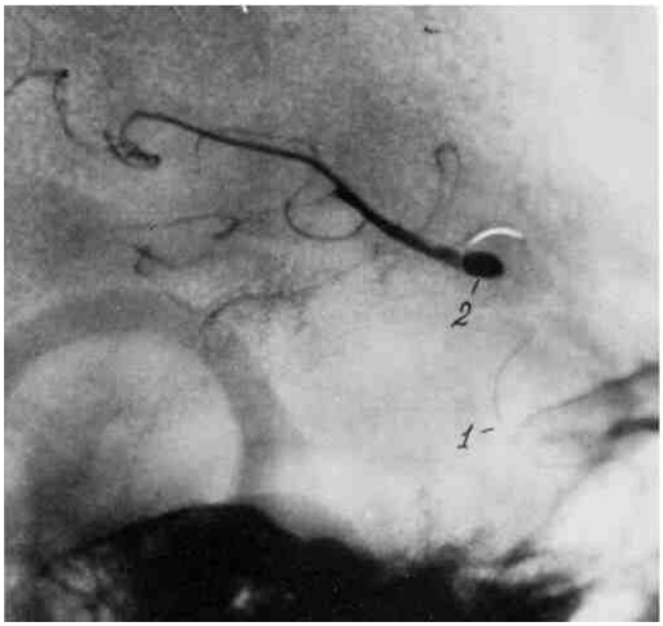


FIGURE 4. Selective angiography of a branch of the middle cerebral artery performed by Serbinenko during the late 1960s using a dual lumen balloon microcatheter (a forerunner of the calibrated leak balloon). 7, catheter; 2, balloon *(from,* Serbinenko FA: Balloon catheterization and occlusion of major cerebral vessels. J Neurosurg 41:125-145, 1974 [28]).

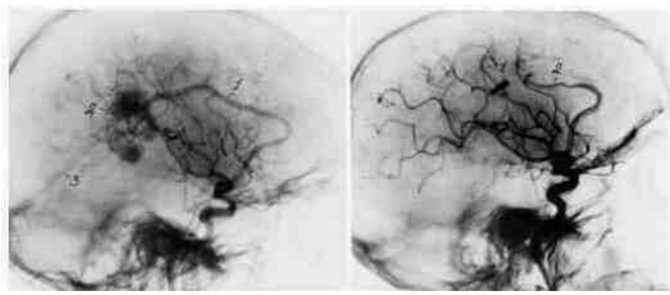


FIGURE 5. Permanent balloon occlusion of a cerebral AVM feeding artery performed by Serbinenko during the early 1970s. *A,* lateral carotid angiogram demonstrating an AVM fed by an enlarged pericallosal artery. *1,* pericallosal feeding vessel; *2,* AVM nidus; *3,* early opacification of the straight sinus. *B,* angiogram after balloon embolization of feeding vessel. 7, balloon; 2, proximal pericallosal artery *(from,* Serbinenko FA: Balloon catheterization and occlusion of major cerebral vessels. J Neurosurg 41:125-145, 1974 [28]).

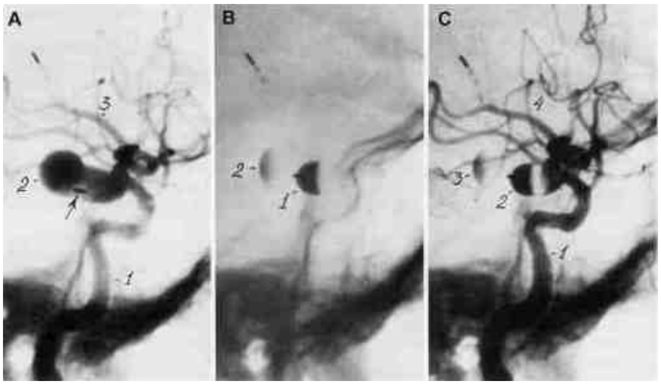


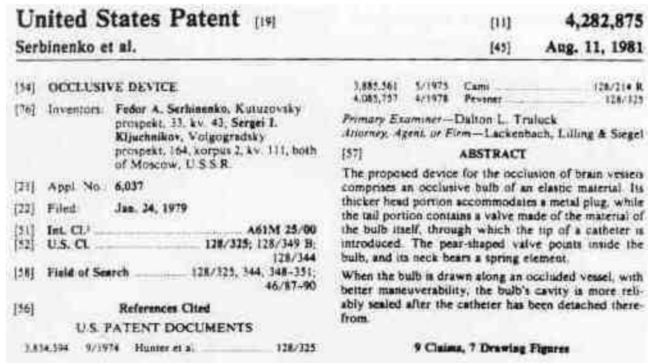
FIGURE 6. Occlusion of a posterior communicating artery saccular aneurysm performed by Serbinenko in the early 1970s using his detachable balloon device. *A,* lateral carotid angiogram immediately after placement of noninflated balloon with radiopaque marker within the aneurysm cavity. *Arrow,* balloon marker; *1,* internal carotid artery; 2, aneurysm fundus or dome; *3,* branch of the middle cerebral artery. *B,* lateral cranial radiograph showing balloon (7) inflated with contrast material and stagnant contrast material layering within the aneurysm dome (2). *C,* lateral carotid angiogram after withdrawal of catheter from balloon, demonstrating aneurysm occlusion. Note layering of contrast material and opacified silicone polymer within the balloon. *1,* internal carotid artery; 2, balloon; *3,* contrast material trapped in aneurysm dome; 4, branch of middle cerebral artery *[from,* Serbinenko FA: Balloon catheterization and occlusion of major cerebral vessels. J Neurosurg 41:125-145, 1974 [28]).

therapeutic cerebral vascular occlusions, treating aneurysms, CCFs, and major feeding vessels to AVMs, with only two reported deaths (28). Serbinenko devised a balloon incorporating a tiny distal radiopaque gold pellet. This created a heavy tip and conferred on the device greater fluoroscopic visibility and directional properties *(Fig. 7). A* similar device used in conjunction with a nondetachable "shepherd balloon" was employed by Shcheglov to occlude intracranial aneurysms (26, 30) *(Figs. 8* and 9).

Although most of his early work was performed through direct carotid punctures, Serbinenko later adopted the transfemoral Seldinger technique for his endovascular procedures (also referred to at the Burdenko Institute as *endovasal* procedures). Carefully and methodically he amassed an impressive patient series. To date, more than 3000 patients have been evaluated and/or treated by Serbinenko using balloon catheter techniques (19).

THE ESTABLISHMENT OF A NEW MEDICAL SPECIALTY

To their credit, a number of researchers in the 1960s and early 1970s had reported or proposed the use of endovascular techniques to treat neurovascular lesions. These included Luessenhop and Spence (20), who embolized cerebral AVMs



United States Patent [19] [11] **4,282,875**
Serbinenko et al. [45] **Aug. 11, 1981**

[54] OCCLUSIVE DEVICE

[76] Inventors: **Fedor A. Serbinenko**, Kutuzovsky prospekt, 33, kv. 43; **Sergei I. Kljuchnikov**, Volgogradsky prospekt, 164, korpus 2, kv. 111, both of Moscow, U.S.S.R.

[21] Appl. No.: **6,037**

[22] Filed: **Jan. 24, 1979**

[51] **Int. Cl.**[3] **A61M 25/00**
[52] **U.S. Cl.** .... **128/325**; 128/349 B; 128/344
[58] **Field of Search** 128/325, 344, 348-351; 46/87-90

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Primary Examiner—Dalton L. Truluck
Attorney, Agent, or Firm—Lackenbach, Lilling & Siegel

[57] **ABSTRACT**

The proposed device for the occlusion of brain vessels comprises an occlusive bulb of an elastic material. Its thicker head portion accommodates a metal plug, while the tail portion contains a valve made of the material of the bulb itself, through which the tip of a catheter is introduced. The pear-shaped valve points inside the bulb, and its neck bears a spring element.

When the bulb is drawn along an occluded vessel, with better maneuverability, the bulb's cavity is more reliably sealed after the catheter has been detached therefrom.

9 Claims, 7 Drawing Figures

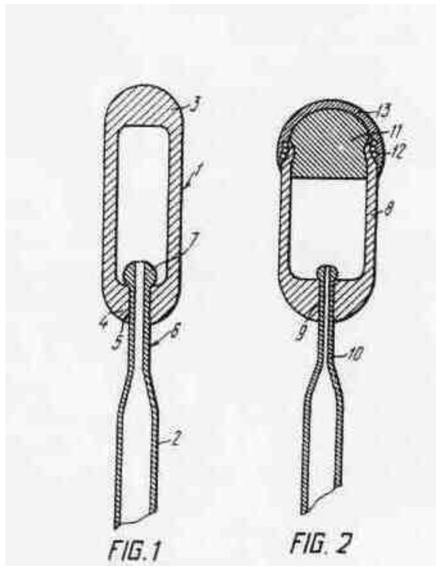

FIGURE 7. United States Patent 4,282,875 granted to Fedor A. Serbinenko and Sergei I. Kljuchnikov, August 11, 1981, for a "... device for the occlusion of brain vessels. ..." *Figure 2* shows a balloon device incorporating a heavy metal pellet in the distal portion of a detachable balloon.

therapeutically and attempted to treat a supraclinoid carotid aneurysm using an intravascular silicone balloon (21); Alksne and Fingerhut (1), who performed magnetically assisted transarterial embolization of experimental canine aneurysms; and Prolo and Hanbery (25), who described the transluminal occlusion of a CCF using a nondetachable balloon. The work of these and other early investigators was visionary, and eventually the work of Luessenhop would influence the management of central nervous system AVMs (2, 32). However, Serbinenko's innovations rapidly led to widely applied new therapies that would eventually change the course of neurosurgery. Therefore, it can be argued that Serbinenko's invention of the balloon catheter in the 1960s and the achievement of the first successful permanent balloon occlusion of an intracranial vessel using his device in 1969 were the seminal events marking the birth of endovascular neurosurgery. These developments made possible, for the first time, effective

FIGURE 8. Serbinenko with friend and pupil Victor Shcheglov *(left)* in 1979.

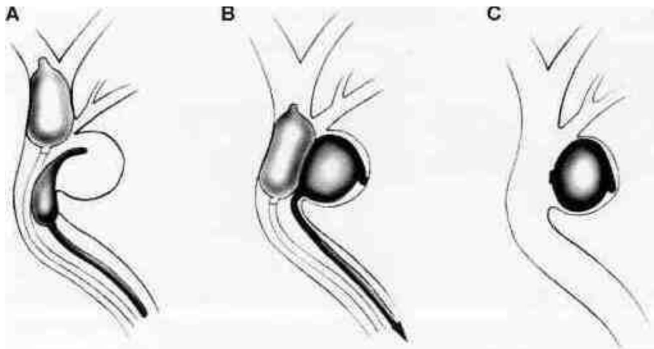

FIGURE 9. Aneurysm balloon embolization technique inspired by Serbinenko and used by Shcheglov. Two balloon catheters are advanced into the internal carotid artery. *A,* the nondetachable balloon catheter is advanced beyond the cerebral aneurysm and acts as a "shepherd balloon" that guides the detachable balloon into the aneurysm sac. The detachable balloon has a heavy metal tip, which aids its maneuverability. *B,* once the detachable balloon is filled with a silicone polymer (thus occluding flow into the aneurysm), the shepherd balloon can brace it in place and facilitate separation from its delivery catheter. The shepherd balloon may also be used to occlude the parent vessel if the aneurysm ruptures inadvertently during these manipulations. C, final endosaccular deployment of the inflated balloon.

therapies for a variety of neurovascular lesions. The basic concepts pioneered by Serbinenko 30 years ago for the treatment of CCFs, AVFs, and inoperable cavernous internal carotid artery fusiform aneurysms (as well as the later adoption of his invention for angioplasty of postsubarachnoid hemorrhage vasospasm [36]) remain just as viable and important today.

Serbinenko's burgeoning endovascular practice demanded all of his time, forcing him to abandon conventional operative neurosurgery. However, his focus on endovascular procedures opened a new chapter in the investigation of cerebrovascular pathophysiology. With the collaboration of the late neuropsychologist Alexander Luria, also of the Burdenko Institute (19), Serbinenko's balloon test occlusion of cerebral arteries (27, 28) aided in brain mapping and presurgical assessment of potentially eloquent areas of the cerebral cortex. These temporary balloon occlusions, similar to current selective Wada tests performed by the injection of sodium amytal, were complemented by electrophysiological and biochemical studies. The results obtained from these diagnostic procedures expanded our knowledge of the brain's functional neurovascular territories.

NEWS OF SERBINENKO'S INNOVATIONS SPREADS

In 1971, at the first All Soviet Neurosurgical Congress held in Moscow, Serbinenko presented his cumulative endovascular experience in a dynamic talk that captivated the audience. That same year, he published his landmark article describing the use of his balloon catheter for the diagnosis and treatment of cerebrovascular disorders (27). Despite the barriers to the exchange of ideas between East and West created by the Cold War, such revolutionary new concepts could not help but have an impact on medical thinking worldwide. In 1974, another article reporting his endovascular neurosurgical results was published in the *Journal of Neurosurgery* (28). Thereafter, the Burdenko Institute became a mecca for foreign physicians wishing to observe neurointerventional techniques *(Fig. 10). A* notable visitor was Gerard Debrun from Creteil, France, who, by the time of his arrival at the Burdenko Institute in 1975, had completed preliminary work on his own version of a detachable latex embolization balloon (5, 7).

Recognition of Serbinenko's work created opportunities for other Soviet neurointerventionalists, including the late Y.N. Zubkov from the A.L. Polenov Neurosurgery Institute in Leningrad (now St. Petersburg) and V.I. Shcheglov *(Fig. 8)* from the Kiev Research Institute of Neurosurgery. Their publications describing balloon microcatheter techniques further validated Serbinenko's work (26, 30, 36). A balloon-mounted microcatheter would eventually be used by Zubkov for angioplasty of cerebral vasospasm after subarachnoid hemor-

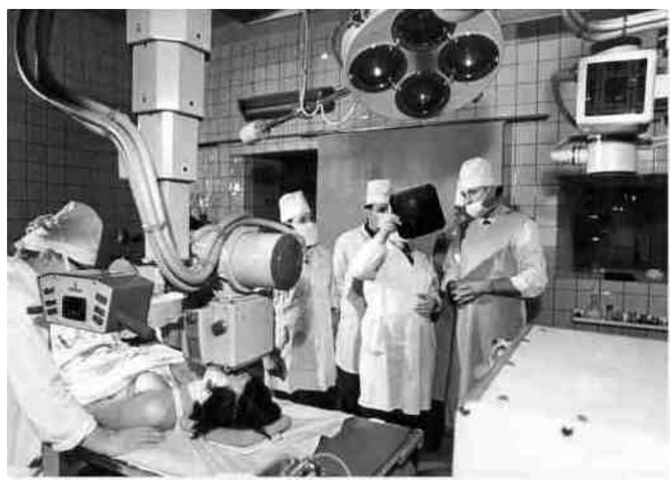

FIGURE 10. Serbinenko *(far right)* and assistants during an endovascular neurosurgical procedure in the Siemens angiography laboratory at the Burdenko Institute in 1976.

rhage (36). The wide applicability of endovascular techniques was demonstrated to future *Neurosurgery* editor Michael L.J. Apuzzo by Shcheglov during a visit to Kiev in 1988.

Serbinenko's work spawned numerous innovations by other investigators around the world, leading to a technological explosion and the current wide application of neurointerventional techniques. In the late 1970s and early 1980s, Debrun et al. (4, 6, 8) reported their results using the Debrun latex balloon (Nycomed-Ingenor, Paris, France) in the treatment of cerebral aneurysms and CCFs. The introduction of nondetachable balloon catheters (using either latex or silicone balloons) made balloon test occlusions of the carotid and vertebral arteries practical. The same type of device has been used by Theron et al. (31) for balloon protection of the cerebral circulation during carotid angioplasty and stenting procedures.

The calibrated leak balloon (a variation of Serbinenko's invention), investigated by Kerber (18) and others (6), afforded antegrade flow arrest within AVM feeding arteries during embolization of the AVM nidus with a liquid adhesive agent. This work was accompanied by efforts to improve the embolic qualities of cyanoacrylate (3). However, the subsequent development of supple flow-directed and over-the-wire microcatheters greatly expanded the role of embolization in the treatment of AVMs (32).

In the late 1970s, Hieshima et al. (14) developed a silicone detachable balloon with a self-sealing valve (Interventional Therapeutics Corp., South San Francisco, CA, and more recently Target Therapeutics, Fremont, CA), which was more compliant than latex balloons. This device has been used to treat CCFs, AVFs, intracranial aneurysms, AVM feeding arteries, and neurovascular traumatic lesions (15-17). Detachable silicone balloons were typically inflated with an isoosmolar iodinated contrast agent and occasionally a mixture of metrizamide contrast and hydroxyethyl methacrylate, a polymerizing agent that is incompatible with latex balloons. This device is the only United States Food and Drug Administration-approved detachable balloon available in the United States. In the late 1970s, White et al. (33) also developed a detachable silicone embolization balloon used in the treatment of spermatic vein varicoceles, pulmonary AVFs (associated with hereditary hemorrhagic teleangiectasia), and other AVFs (33-35).

By 1990, a number of groups had amassed considerable experience using detachable balloons to treat intracranial aneurysms with parent artery preservation (16, 24, 30). However, Higashida et al. (16) reported death and stroke rates of 17.9% and 10.7%, respectively, associated with endosaccular aneurysm balloon embolizations. Moret (24) reported a 10% incidence of technical failures, a 4% death rate, and a 10% rate of neurological complications during these procedures. It was obvious that a more precise, reliable, and safe means of endovascular occlusion of saccular aneurysms was needed. This was achieved with the introduction of the Guglielmi detachable coil (Target Therapeutics) (12, 13), which received Food and Drug Administration approval in 1995 and immediately supplanted detachable balloons for endosaccular aneurysm embolizations. However, despite the dominance of newer coil technology, Serbinenko's invention still finds a niche in aneurysm embolizations in association with the balloon remodeling technique of Moret et al. (23), in which Guglielmi detachable coils may be used to treat wide-neck aneurysms.

ACCOLADES FOR THE ENDOVASCULAR PIONEER

In recognition of his many contributions to medicine, Serbinenko has been awarded honorary membership in multiple international scientific and medical societies, including the American Society of Neuroradiology. In 1976, the Soviet State Prize was bestowed on him in recognition of his invention. In 1986, he became a member correspondent of the Russian Academy of Medical Sciences, and in 1995, he became an academician. Serbinenko was a special honoree during the 1999 Scientific Conference of the World Federation of Interventional and Therapeutic Neuroradiology.

Serbinenko serves as the Burdenko Institute's Vice-Director of Scientific Affairs and is scientific secretary of the Specialized Council for Thesis Defense. He is also a member of the editorial board of *Voprosy Neurochirurgii.* He has authored or co-authored more than 150 scientific publications and holds 11 patents for medical devices in Russia, the United States, Germany, Sweden, Canada, Japan, and France *(Fig. 7).*

SERBINENKO: THE PERSONAL SIDE

Serbinenko is known as a driven and exacting physician and researcher. In the name of patient care, he expects nothing less than maximal effort from his colleagues and co-workers, but most of all from himself. He can conceive of no greater expression of compassion for his patients than consistently delivering excellent medical care. Beneath this thin veneer of a demanding taskmaster resides a warm and compassionate sentimentalist. His genuine sense of concern extends beyond patients and colleagues to include people in general. He never is too busy or thinks himself too important to find time to write a personal note to a friend, remember a special occasion, do a small favor, or comfort the family of an ailing patient. These are the characteristics for which Serbinenko is most admired and respected.

Serbinenko met his wife, Maya *(Fig. 11), who* holds a doctorate in neurophysiology, while he was a medical student. Because of their similar upbringing, the two found that they shared much common ground. Their friendship blossomed into a loving relationship that has strengthened and deepened over the years. Maya has truly "completed" Fedor, providing him with support and encouragement that has sustained him during his demanding career. They have a daughter, Natalia, who is also a physician. Although the Serbinenkos have a home in Moscow, they spend all of their vacation time in the heart of the Russian countryside near the banks of the Volga River in the Kostroma. In his country home, Serbinenko enjoys spending countless hours in his workshop, tinkering with all manner of devices. His interests include literature, ballet, and history.

THE FINAL ANALYSIS

Years from now, when medical historians revisit the 20th century, what will be the legacy of Serbinenko? It will be the

FIGURE 11. Maya Serbinenko in 1958.

knowledge that great ideas or inventions, which act as catalysts for sweeping change in any field of human endeavor, usually are born of great patience and enormous effort while formidable obstacles and disappointments are overcome. Such ideas and inventions require the courage, faith, and determination to nurture and stand by one's dreams even if they seem contradictory to conventional wisdom. Having stood by his dreams so tenaciously, Serbinenko joins the other great architects of endovascular surgery, including Moniz (22), Dotter (9, 10), and Gruentzig (11).

In his doctoral thesis, Serbinenko described endovascular neurosurgery as the "knot that deserves to be untied." His lifelong desire to unravel the Gordian knots of scientific mysteries has served him well during his long and productive career. He dedicates his remaining active years to training as many young physicians in his specialty as possible, thus passing the torch to the next generation. Because of Serbinenko, Russia will be known as the birthplace of endovascular neurosurgery. As we enter the new millennium, his numerous friends and colleagues around the world salute this visionary pioneer and wish him many more years of health and happiness.

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COMMENTS

The authors have done a remarkable job presenting, both biographically and scientifically, an important personage in neurosurgery, Fedor Serbinenko. One of the tragedies of the Cold War was the lack of interchange that occurred at many levels of science and medicine because of political limitations. As a result, many of the original contributions of our Russian (and former Soviet) colleagues were not adequately shared with the Western world. This article reveals a patriotic Russian who surmounted incredible hurdles to develop technically advanced equipment for endovascular procedures. A serendipitous observation of helium balloons at a May Day celebration led Dr. Serbinenko to develop the concept of a flow-guided catheter. With equipment and engineering facilities far less advanced than elsewhere in the world, it remains even more amazing that he was able to accomplish so much with so little—a tribute to his tenacity and scholarship. The biographical background, enhanced by important historical illustrations, provides additional breath and depth to the article. Dr. Serbinenko was an important and remarkable catalyst to the burgeoning field of endovascular intervention. He stood by his dreams and can truly be called one of the originators and pioneers in endovascular surgery. I have visited the former Soviet Union a number of times during the last decade and have always been impressed with the tenacity and intelligence of our Russian colleagues. There are more "stories" like this out there, and it is my fervent hope that other biographical vignettes will be published. It would be tragic not to share these remarkable medical and scientific careers and achievements with our Western colleagues. The authors have presented a rich and enlightening biographical study of one of the great figures in modern Russian neurosurgery.

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If there were a Nobel Prize for clinical experimentation and research, surely Dr. Serbinenko would be one of the neurosurgeons considered for such an honor. It is usually a very courageous, innovative, and insightful individual who is able to make the kind of contribution that Dr. Serbinenko provided, and very few individuals have the opportunity to become genuine pioneers in novel areas of neurosurgical practice. There is a rich history of attempts to use endovascular access to solve vexing clinical problems. One marvels at the courage of individuals like Sauerbruch, who tested the concept of cardiac catheterization by catheterizing his own brachial artery and reaching his own heart. Others had innovative ideas with regard to endovascular treatment; Barney Brooks used endovascular pledgets of muscle to treat arteriovenous fistulae, and Alfred Luessenhop successfully developed silicone spheres to occlude the vascular supply of arteriovenous malformations and some tumors. Dr. Fogarty's catheter has been used in many branches of vascular and neurovascular surgery and is a valuable adjunct. After Serbinenko's original description, other balloon technologies were developed, Guglielmi introduced endovascular coils, and recently the first practical uses of endovascular stenting have been clearly demonstrated.

Our colleagues who use endovascular therapy in specialty and subspecialty areas tend to agree that Serbinenko deserves credit for demonstrating the great promise that these endovascular approaches offer for treating a variety of neurosurgical problems. Serbinenko was able to develop a school of Russian endovascular surgeons who continue to develop both the technology and its applications.

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Like most Westerners, I discovered Dr. Serbinenko's pioneering work in 1974, when he published his article in English in the *Journal of Neurosurgery*. I was amazed and frustrated, however, to realize that I had missed his initial works, published much earlier in the Russian literature. There is no doubt that Dr. Serbinenko opened the era of modern endovascular surgery, followed by his colleagues V.I. Shcheglov and Y.N. Zubkov. It is amazing to observe an autocratic society making major discoveries years before anyone else in the world and extending the great tradition of Russian neurology.

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