To neurosurgeons in countries all over the world, the challenge of cerebral aneurysm surgery is exhilarating and gratifying. To successfully clip a difficult aneurysm which can at any instant explode in front of the surgeon's eyes, threatening the patient's life, produces the feeling of fulfillment of one's dream of saving lives that is most satisfying to a physician. It is akin to the "good guy" winning the "shoot-out" in an old western movie.

However, this era is fading for neurosurgeons, just as the time of the "Wild West" has become so distant that it has been replaced by space exploration and the marvels of computers. And just like the "Wild West" with which so many are familiar, it is hard to see it go. But it is surely passing.

The advances in science have produced fantastic technology, currently in its infancy, but still the beginning of a new era in the treatment of nervous system diseases using endovascular or interventional techniques. Reports from centers in France and the U.S. have demonstrated that selected aneurysms can be successfully obliterated by endovascular techniques, which are less stressful and invasive to the patient than traditional surgery. In selected cases, 70% of aneurysms can be completely obliterated without a craniotomy and with a hospital stay notably shorter than that of an operated patient. The treatment is not perfect: some aneurysms (20%) recanalize or have neck remnants—but this also occurs with traditional surgical approaches. A very small number of patients (3%) suffer complications from endovascular treatments. Yet, as I have watched these aneurysms being obliterated with less morbidity than I could achieve surgically, I am convinced that endovascular treatments are an essential approach to the successful cure of this disease.

Other uses of interventional techniques include the treatment of vasospasm. Intra-arterial papaverine or angioplasty offer excellent therapeutic options for patients with severe vasospasm, which can be lifesaving. Finally, I have believed for years that it makes little sense to wait until an aneurysm ruptures and then treat it with such high risks of mortality and morbidity. We have in our hands the ability to treat the disease before it becomes acute.

Before the advent of MR angiography, the only screening technique was conventional angiography, which was impractical. But now, MRA can be used as a screening procedure, as is being done in Japan, to detect unruptured aneurysms so that they can be treated before a life-threatening hemorrhage occurs. Screening procedures to reveal intracranial aneurysms should become as widely used as a chest x-ray in evaluating patients.

The problem is that neurosurgeons are not as involved in the treatment of this challenging disease as they were in the past—radiologists are! And the radiologists now earn the pleasure, gratification, and pay for treating it. That hurts neurosurgeons more than anything. But it does not have to be so. Neurosurgeons should become endovascular surgeons; unfortunately, many are reluctant to change. Neurosurgeons have become complacent in yet another area—as they have in spine, peripheral nerve surgery, and extracranial vascular surgery—to the point where others who have been creative and aggressive have surpassed the neurosurgeon by offering a treatment which is superior to the conventional neurosurgical approach. There are no new technological surgical advances, such as the introduction of the operating microscope over 25 years ago, which promise to alter this trend toward endovascular treatment.

How is the neurosurgeon reacting to these advances? Many reactions are similar to the stages of mourning a death. First there is denial—the initial reaction of neurosurgeons around the world. Neurosurgical journals have refused to publish papers on this topic. Secondly there is anger, the stage in
which most neurosurgeons now find themselves. In this stage, neurosurgeons are critical of the reports and widely declare them to be untruthful. Eventually neurosurgeons will reach the stage of acceptance and will then be at peace with themselves, as this perceived threat to their welfare is resolved.

Currently, the best aneurysms to treat with coils are those with a small neck and a large, round sac. These are also the easiest aneurysms for the surgeon to clip. The locations most suited to coiling are the paraclinoid, some posterior communicating and anterior choroidal, anterior communicating, basilar tip and trunk, vertebrobasilar junction, and some posterior inferior communicating artery aneurysms—all assuming that the geometry of the aneurysm is correct. For aneurysms with a wide neck or complicated geometry in any location, surgical clipping is still the better treatment option. If the geometry of the aneurysm is not good for coiling, then surgical clipping is the next best treatment, with the next lowest risk and best outcome.

But what about the complicated aneurysms that cannot be coiled? These cases are the ones reserved for the neurosurgeon, and approaching a difficult aneurysm to clip it is a formidable challenge. So the neurosurgeon of the future will be operating on complicated cases not amenable to coiling or endovascular approaches—that is, until endovascular technology emerges which will be better able to treat these aneurysms.

Having been personally involved in the surgery on over 1200 cerebral aneurysms in all locations and knowing my risks and complications, and having seen close to 200 aneurysms treated with coils, it is easy to determine whether the endovascular approach performed by an honest and technically skilled endovascular surgeon will have a lower morbidity than clipping. My associate in interventional neuroradiology, Gerard Debrun, and I judge that clipping will be the preferred method of treatment 50% of the time. Neal Kassell in Virginia and Bernard George in Paris estimate the rate to be 70–80%. Takashi Yoshimoto in Sendai, one of the world leaders in aneurysm work, is using coils for aneurysms; Nick Hopkins in New York and Neil Martin in California have similar viewpoints on the value of endovascular approaches to intracranial aneurysms. All of them work with interventional neuroradiologists or have learned the techniques themselves.

In our practice, the interventional neuroradiologists are members of the neurosurgery department. They have admitting privileges and their patients are cared for by the neurosurgery residents. They bill their interventional work though the neurosurgery department and their diagnostic studies through radiology. Both departments have benefited. We have seen our aneurysm business double since they have joined us; we are treating cases we might not have seen previously because they would have been considered inoperable. By working together, we have developed unique approaches to complex cases which were not possible for either of us separately. Thus, the issue of income does not divide us or keep us from progressing. It is true that this arrangement would be politically difficult in many centers; however, it can assure both the neurosurgeon and the endovascular surgeon of success, and the medical center of the most advanced therapies.

Our decision on which method to use in treating any patient with an intracranial aneurysm is made by considering the options available and choosing the one which has the lowest risk and the highest benefit to the patient. If the first treatment method is not successful, we try the option with the next lowest risk and highest benefit. This collaboration requires both the neurosurgeon and the interventionalist to be extremely honest about what they think they can achieve with each approach. In our institution, if the geometry and location of the aneurysm make it suitable for coiling, we will offer this as our first choice for the patient, since it is our belief that most patients would prefer not to have a craniotomy if at all possible. If one wishes to retain all the patients for his or her own method of treatment—surgery or coiling—the collaboration will fail.

How soon will this trend reach the general practice of neurosurgery? First, it will be necessary to train good endovascular radiologists or neurosurgeons. This step will probably take 10 years. However, other considerations will arise. Insurance companies and physician organizations which contract for health care will realize that the costs of coiling and other endovascular approaches are less than those of surgical clipping. The decision to utilize the endovascular route will therefore be made economically, not medically. Secondly, research will show that the endovascular techniques produce less neural disturbance than a craniotomy. At this point, the arguments in favor of surgery will become untenable. It will take longer for this trend to manifest in the developing world, although in Argentina, an interventional radiologist is already treating many intracranial aneurysms by coiling.

So, what should neurosurgeons do? There are several choices. (1) You can continue until you must abandon or slowly lose your aneurysm business. (2) You can learn endovascular techniques (and make no mistake about it, you must devote
100% of your time to endovascular work to become skilled at it, just as you did in neurosurgery. (3) You can combine with an interventional neuroradiologist in your practice and offer the services of both a neurovascular surgeon and an endovascular surgeon. (4) You can ignore the whole thing and mount critical attacks on the proposals. Ultimately, this last option is doomed to fail.

If I were the CEO of an interventional neuroradiology company, I would fund research and development projects which would improve this technology. I would work on a new form of stent which could cover the neck of the aneurysm and obliterate it more easily than coils. I would use 3D CT endovascular imaging which would reveal the anatomy of the vessel at the site of the aneurysm so that I could manufacture stents which could be molded to fit that region of the vessel.

And remember that the original idea for endovascular approaches to the cerebral circulation was developed in Russia in 1974 by Serbinenko and was used in the treatment of cerebral aneurysms with balloons by Sheglov, also a Russian. An Italian neurosurgeon named Guglielmi who had an engineering background developed the concept of an aneurysm coil with an electric release. So if you believe you don’t need to know about what is happening in other countries, or that countries not considered “advanced” could not possibly develop innovative ideas, you might as well order your casket, because you just died.

The world of medicine in which we live is changing rapidly. Challenging and innovative ideas are being proposed by people all over the world. We are part of a medical “society” made up of aggressive, competitive individuals. There is no room for complacency. Endovascular techniques for the treatment of intracranial aneurysms are here to stay.

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