The very experienced endovascular group of Sluzewski and colleagues presents us with a candid assessment of the complications and the short-term clinical and angiography results of balloon assisted coil embolization (BACE) of intracranial aneurysms. Their study is important because other groups have reported a relatively low incidence of complications with this technique; the incidences in the largest six studies in the literature range from 0 to 5.3%. Sluzewski and colleagues treated 71 aneurysms using the balloon-assisted technique. During the 10 years of their study, they treated an additional 756 aneurysms with coils without balloon assistance. In the group treated with balloon assistance, there was a 14.1% incidence of serious procedural complications leading to death in six patients and dependency in four. Of these complications, seven were thromboembolisms and three were intraprocedural ruptures. In contrast, the procedural complication rate in patients treated without balloon assistance was only 3% (death in 1.7% and dependency in 1.3%); 17 of the 23 complications in this group were thromboembolisms and six were procedural ruptures. This difference is very significant statistically, although, of course, the two groups are not comparable given that balloon assistance was used only for large and/or broad-based aneurysms in which CE without balloon assistance was believed to be impossible or had failed.

These authors also addressed the issue of effectiveness, although this assessment has less value given that the follow-up period was relatively short. There was no significant difference between the degree of packing at the time of treatment in the groups treated with or without balloon assistance. Most patients underwent 6-month follow-up angiography studies. At that time, of the aneurysms treated with balloon assistance, 71% demonstrated more than 90% occlusion (“complete or near-complete occlusion”), and 29% remained incompletely occluded. In contrast, the rate of incomplete occlusion at 6 months posttreatment in aneurysms treated without balloon assistance was 16.9%. Of the lesions treated with balloon assistance, 16.9% required further treatment (additional coil placement procedures or surgeries) compared with only 9% of those treated without balloon assistance. Clinically, the patients who did not suffer a complication initially fared generally well. At a median follow up of 28 months, there were no repeated bleedings, and only one patient died of progressive brainstem compression from a large basilar top aneurysm in which coils had been packed twice.

The importance of this article is that Sluzewski and associates point out that BACE of intracranial aneurysms may not be as safe as previously indicated. One could argue that perhaps these authors do not have sufficient experience with the endovascular treatment of aneurysms; however, the fact that during the study period they treated an additional 756 aneurysms without balloon assistance while achieving very good results makes this argument less tenable. Clearly, at the very least, their article should make us reconsider the
indications for coil packing of aneurysms when it can be presumed that balloon assistance will be needed. As the authors have pointed out, surgery is frequently a very good alternative, and in most cases, in fact, it may be the best alternative for broad-based aneurysms in which predictably balloon assistance will be needed if coil placement is attempted. Of course, this statement must be qualified because there is no question that broad-based and larger aneurysms present a greater surgical risk than smaller aneurysms with narrow necks.

The decision to treat an aneurysm is relatively easy in patients who present with a ruptured lesion given the well-known high risk of repeated bleeding. The issue in these patients then is the choice of the most appropriate treatment method. The sobering 14.1% rate of very serious procedural complications reported by these authors makes me think that, in general, surgery would be preferable for most, but not all, ruptured aneurysms when one can predict that balloon assistance will be needed if endovascular treatment is chosen. However, it is clear that in many circumstances—because of the neurological condition of the patient or the location of the aneurysm—the high rate of complications that can be expected with balloon assistance would be still lower than the expected surgical morbidity rate. Such may certainly be the case in patients with a poor neurological grade when the brain can be expected to be “red, angry and swollen.” At least in my hands, the 14% complication rate reported in their article is still lower than what I can achieve with open surgery in a ruptured broad-based basilar artery (BA) aneurysm. In patients with a good neurological condition in whom brain swelling and friability are generally not major problems, most experienced neurovascular surgeons can anticipate a lower procedural complication rate than has been reported by Sluzewski and colleagues in using BACE, even in relatively broad-based aneurysms of the anterior circulation and the vertebral artery–posterior inferior cerebellar artery region.

The situation with unruptured aneurysms is very different. First, brain swelling and friability are not issues under these circumstances. Second, we have learned that the natural history of unruptured aneurysms is relatively benign, with an expected annual rupture rate of generally 1% or less. Third, given this low yearly rupture risk, the treatment goal in a patient with an unruptured aneurysm is not so much protection against early repeated bleeding (something we know coil packing can provide) as long-term efficacy. We cannot yet tell whether CE with or without balloon assistance will provide for such a goal considering the relatively short-term follow-up data available in these patients. Given these considerations, I found it surprising that of the 71 aneurysms these authors treated with balloon assistance, 26 (36.6%) were unruptured. Does a 14% serious procedural complication rate ever justify treating an unruptured aneurysm by using BACE? Clearly, there may be such circumstances, as in a patient with, for example, a large or giant BA aneurysm causing progressive symptomatic brainstem compression and whose natural history may justify using such a high-risk technique given that the alternative surgical repair may well carry an even higher complication rate. Certainly, the instances in which a treatment with this high risk for an unruptured aneurysm is justified must be few and far between.

In summary, I am thankful to the authors for their very honest assessment of the results of BACE of intracranial aneurysms. The high complication rate reported by this respected and experienced group should make us all strongly consider alternatives to this form of treatment. Most often that alternative will be open surgery, but we must keep an open mind and carefully assess the pros and cons of new endovascular technical developments such as stents, which may make it possible endovascularly to treat these more complex types of aneurysms with a higher probability of success. For now, what we can say with considerable confidence is that the treatment of patients with intracranial aneurysms must be highly individualized and take into consideration many factors such as whether the aneurysm is ruptured; its location, size, and shape; the condition and age of the patient; the experience of the treating team; and so forth. Clearly, to have a predetermined policy that in effect dictates that all aneurysms must be treated in one way or another unless said treatment is impossible—as unfortunately exists today in some centers and even in some countries around the world—is wrong. Each patient is best served by being treated at a center where all options are available and considered critically in reference to that individual patient and the best option for him or her.

Response: We thank Drs. Meyer and Heros for their comments on our article. First, we would like to clarify our considerations in treating the 26 unruptured aneurysms with BACE. Three of these aneurysms had ruptured more than 6 weeks before CE and acute clip application had failed. At the time of coil insertion, these lesions were considered to be unruptured. Seven patients demonstrated severe symptoms of mass effect, and one patient presented with a carotid artery cavernous fistula. Nine aneurysms were additional to another ruptured aneurysm, and only six aneurysms (all > 10 mm) were found incidentally.

We agree that the decision of whether to apply a clip or insert a coil in a patient with a large, broad-based intracranial aneurysm depends on many factors and should be made carefully by a neurovascular team. Both Drs. Meyer and Heros state that for difficult aneurysms, surgery may be a better alternative than BACE in most cases. We have some remarks concerning this assertion.

For many years at our institution, a mean of 200 aneurysms have been treated every year. Since the introduction of endovascular treatment alternatives, we have discussed all cases of intracranial aneurysms in a joint meeting with two vascular neurologists and four experienced vascular neurosurgeons. In general, for difficult aneurysms located in both the anterior and posterior circulations but nonetheless amenable to parent vessel occlusion, we prefer this therapy because it is simple and effective. During the 10-year period of the study, 62 carotid artery aneurysms and 40 posterior circulation aneurysms were treated using endovascular parent vessel occlusion, with good results; however, these cases were not included in our analysis. Over the last 12 years, the proportion of aneurysms treated with endovascular techniques (CE and parent vessel occlusion) at our institution rose gradually to 85%. Surgery is now restricted to good-grade patients with anterior circulation aneurysms unsuitable for coil insertion or parent vessel occlusion, that is, mostly difficult aneurysms with vessels arising from its sac. Surgery for ruptured or unruptured BA aneurysms is seldom considered an option, because we have found better outcomes after coil insertion than after clip application in