Cardiac standstill

GIUSEPPE LANZINO, M.D., AND PHILIPP TAUSKY, M.D.

Department of Neurosurgery, Mayo Clinic, Rochester, Minnesota

Even with modern endovascular techniques, very large or giant complex posterior circulation aneurysms represent formidable treatment challenges. In the present issue of the Journal of Neurosurgery, the group from the Barrow Neurological Institute6 presents their updated experience with 105 cardiac standstill procedures in 103 patients with very large or giant aneurysms. More than 90% of these procedures were performed for posterior circulation aneurysms.

While cardiocirculatory arrest provides a bloodless field, softens the aneurysm, and facilitates isolation of the neck and separation from critical perforators, this procedure adds incredible complexities, which relate mostly to the high level of coordination, organization, and teamwork involved in the procedure as well as a high level of specialized experience and skill of all participants. Having been directly involved in the planning of some of these procedures (G.L.), I have been made aware of the complex coordination it takes between the neurosurgical team, the neuroanesthesia team, and the cardiothoracic team. Apart from perfect teamwork interaction and technical skills, an incredible attention to detail is needed for the procedure to be successful. All of the elements that come into play for a successful cardiac standstill procedure are difficult to adequately convey in writing. These factors constitute one of the reasons why this procedure has been successfully replicated in only a few other centers. As demonstrated in the authors’ series, the complications for the procedure is high even in the best hands: 15% of patients required additional surgery to evacuate postoperative hematomas, and serious medical complications included 2 episodes of pulmonary embolism (fatal in 1 patient), 1 fatal myocardial infarct, 1 case of transfusion-related hepatitis, and 4 cases of sepsis.

In a series like theirs, which includes ruptured and unruptured aneurysms as well as lesions often deemed inoperable in other places, it is difficult to put the results into perspective. Combined morbidity and mortality amounted to 32% with a perioperative mortality of 14%. Of the 89 patients who were discharged from the hospital, 84 could be followed-up for a mean period of 9.7 years. Seven patients required additional treatment of their aneurysms, and rupture during the follow-up period occurred in 4 patients. At follow-up, 65 patients (63% of the original cohort) were considered to have a “favorable” outcome (Glasgow Outcome Scale [GOS] Scores 4 and 5). Although it has been conventional in surgical series to lump together GOS Scores 4 and 5, there are important differences between these 2 outcome categories. While a GOS score of 5 refers to a patient who “has resumed most normal activities but may have minor residual problems,” patients with a GOS score of 4 are described as being “moderately disabled but independent.” Although an independent status with neurological impairment at follow-up can be considered a good outcome in somebody with a complex posterior circulation aneurysm, many of these deficits and limitations constitute a significant burden to patients and families. A more modern expression and measure of outcome is the percentage of patients who were working before surgery and eventually returned to work. The authors must be commended for including this information. It is remarkable that of the 57 patients who were working before, 31 were able to resume their previous occupation, especially given the full complexity of their disease.

As indicated in the report by Ponce et al.,3 the number of procedures performed at their center has progressively decreased over the past decade. This not only may reflect advances in endovascular techniques but also may relate to developments in skull base techniques, with improved access to some of these complex aneurysms and easier proximal control of the basilar artery, which may obviate the need for cardiocirculatory arrest.3 Additionally, the use of adenosine to induce intraoperative cardiac asystole during critical moments of dissection can be used as an alternative to the cardiac standstill procedure in simpler cases.2 In contrast to their earlier experience with hypothermic circulatory arrest procedures documented in 1998, Ponce and coworkers4 have observed an increase in the overall morbidity and mortality rate. This is probably due to a selection bias, with only very complex cases not amenable to modern endovascular treatment being considered for surgical treatment.

Because of the challenges described, there has been an increasing tendency to refer for endovascular treatment some of the complex aneurysms discussed in their report. The results of endosaccular/endoluminal treatment for many of these aneurysms are far from ideal. However, some of the large and very large aneurysms of the basilar apex and basilar trunk can be effectively treated with current complex endovascular techniques. Although close follow-up and additional coiling is usually necessary, many of these aneurysms tend to stabilize after a while.7 Therefore, especially in elderly patients and in patients with subarachnoid hemorrhage, this endovascular strategy is a valid one in most cases.

Dysmorphic giant aneurysms continue to represent a challenge even in the current endovascular era. Coil em-
bolization is definitely not adequate in preventing further aneurysm growth and rupture. Attempts at initial coil embolizations are often followed by significant recurrences, and incomplete embolizations can cause a new, more complex disease with an incompletely obliterated, growing aneurysm now partially filled with coils. The patients in such cases are probably best treated with a careful individualized approach. Ideally, concentration of these formidable lesions to a few specialized centers around the world is advisable. While some patients might benefit from an endovascular treatment with the understanding that multiple future treatments could be necessary, other patients are better treated with definitive surgical treatment despite the inherent risks. Another often forgotten alternative in some cases is proximal basilar occlusion, which can be safely accomplished with direct clip closure of the basilar artery in patients who have adequate supply from the anterior circulation.6

The last and most challenging category is the patient with fusiform and often dolichoectatic vertebrobasilar aneurysms. There is significant hope that new flow diverters may represent a definite advancement in the treatment of this disease. Despite some early successes,1 however, complication rates are significant even with these newer devices, and definitive treatment is not always achieved.

Overall, this is a landmark experience. Complex posterior circulation aneurysms continue to be a formidable challenge. Cardiac standstill may still be indicated in a very limited number of patients and soon, we hope, only of historical interest for future generations.

References

Response

FRANCISCO A. PONCE, M.D., AND ROBERT F. SPEZTLER, M.D.

Division of Neurological Surgery, Barrow Neurological Institute, St. Joseph’s Hospital and Medical Center, Phoenix, Arizona

The use of cardiac standstill is reserved for the most challenging cerebrovascular lesions that Lanzino and Taussky describe: giant, dysmorphic, and dolichoectatic aneurysms of the basilar artery. The goal in our paper was to highlight the long-term efficacy and protection that the procedure has offered, the rarity with which it is now performed at our institution, and the increased morbidity and mortality rates seen recently.

Although we continue to consider cardiac standstill as part of our armamentarium, in our recent experience with otherwise unclippable basilar apex aneurysms we have favored flow reversal via clip occlusion proximal to the superior cerebellar artery (SCA), accompanied by a superior temporal artery–SCA bypass if necessary—the same procedure that Lanzino and Taussky refer to as the “often forgotten alternative.” In fact, our use of this technique is probably most responsible for our not having used cardiac standstill in recent years.

We are very optimistic about the new options in terms of endovascular techniques, and our endovascular team is tackling aneurysms that might otherwise have been referred for surgical treatment with cardiac standstill a decade ago. There are persistent limitations with regard not only to the regrowth of giant and dysmorphic aneurysms, but also to dolichoectatic aneurysms. We had high expectations that the pipeline stent, mentioned by Lanzino and Taussky, would provide the long-awaited endovascular treatment option for dolichoectatic basilar aneurysms. However, the experience with this device at our institution has been somewhat sobering.

Given the natural history of the aneurysms treated in our cohort, our long-term outcomes show that clipping with cardiac standstill provides lasting protection from hemorrhage. However, the high morbidity and mortality rates associated with cardiac standstill beg for a better alternative. We share Dr. Lanzino’s hope that safer treatment options for these challenging lesions will soon render the technique of hypothermic circulatory arrest for intracranial aneurysms of mere historical interest.

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