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Discussion

DR. ALLEN S. HUDSPETH (Winston-Salem, North Carolina): I strongly endorse the principle of combined carotid and cardiac surgery performed by a single team. This opinion has evolved from an earlier staged approach wherein carotid endarterectomy was done first, if most urgent, or cardiac surgery was done first, if it was most urgent. However, certain patients were encountered whose disease was such that combined surgery was clearly the safest treatment. I've used a different technique than described by the authors and believe it is preferable to this. Although Dr. Kouchoukos and his group have reported good results using hypothermic circulatory arrest, I believe this is making the simple complex. Profound hypothermic circulatory arrest is a useful tool in cardiovascular surgery, and I use it often for surgery of complex congenital or acquire diseases. However, it is not as safe as hypothermic cardiopulmonary bypass and is not necessary for successful execution of combined carotid and cardiac surgery. Using cardiopulmonary bypass with a core temperature of 25 C, I have performed combined carotid and cardiac surgery on 41 patients whose disease was comparable to those described here. There has been no 30-day mortality, no strokes, or evident neurologic changes. This method gives excellent cerebral protection for careful performance of carotid endarterectomies and allows smooth flow of combined operation. It has proven so simple and safe that I no longer stage the stable patients, but proceed immediately with the combined operation. I would encourage this approach over circulatory arrest.

DR. TIMOTHY J. GARDNER (Philadelphia, Pennsylvania): As many of us know, some of Dr. Kouchoukos's most significant contributions to the field of cardiothoracic surgery has been his innovative work toward the avoidance of neurological injury in patients undergoing cardiac surgery procedures. This series of patients presented today, namely, those with significant bilateral carotid artery occlusive disease who require urgent coronary bypass grafting are a particularly troublesome subgroup of patients at high risk of neurological injury, as was well pointed out by Dr. Kouchoukos. Historically, most of these patients judged to require concurrent carotid endarterectomy and bypass grafting have had the carotid surgery done prior to initiating bypass. Recently, some surgical groups—and Dr. Hudspeth's excellent series is an important contribution—the concept of doing the carotid endarterectomy while on bypass with the patient cooled to a moderate level of hypothermia. I think that this is an important point to emphasize. As far as I know, Dr. Kouchoukos is the first one to advocate profound cooling and circulatory arrest for the performance of the endarterectomy. I think it's remarkable that he's accumulated such a large experience in 50 patients, but even more impressive are the outstanding results he's achieved in these high risk patients. I think the absence of neurological complications in this series of patients mandates that we give it careful consideration as an approach to concurrent endarterectomy and bypass grafting. I think, however, the major unresolved question in my mind which really is not answered by this superb series is whether carotid endarterectomy is unequivocally indicated in all of these patients. Two thirds of these patients with bilateral carotid artery disease were in fact asymptomatic. Many of us would argue that concurrent carotid endarterectomy might not be appropriate in all such instances. Clearly, these asymptomatic patients have managed to compensate with respect to cerebral blood flow despite the significant occlusive, even with unilateral carotid artery occlusion. Furthermore, it is possible to alter intraoperative, and even early postoperative, management in such patients to reduce the risk of bypass-induced reductions in cerebral blood flow or postoperative thrombotic complications. While it is certainly difficult to argue with the superb results obtained in these initial 50 patients, it's doubtful that the use of profound hypothermia and circulatory arrest will prove to be without problems in a larger series of patients managed in this fashion. I think it is notable that at least one or more of these patients in Dr. Kouchoukos's series required circulatory arrest for nearly an hour. I think it is, therefore, very important to make sure that the indications for undertaking such a major and risky operative procedure are appropriate. The other thing I think is worth commenting on is that Dr. Kouchoukos's indication is for routine duplex scanning of the carotid arteries in these elderly patients, that is, patients over 65, or in patients who have the presence of neurological signs

or symptoms. Now, do you scan patients younger than 65 who have bruits but are asymptomatic? And another question, how reliably do you detect a complete occlusion which you noted in 24 of these 50 patients by duplex scanning? The other question that I would have is, how can you distinguish—you said that not all of these patients had angiography, that in fact you did the carotid endarterectomy in a certain percentage based on the findings from the scan alone. I would be concerned about misreading the duplex scans and confusing, perhaps, flow restrictions in the external carotid artery with that of the internal carotid artery. I'm a little surprised that you were comfortable planning this surgery based on the scans alone. But I do congratulate you and your associates on an excellent series of patients and for continuing to pursue the most effective techniques for avoiding stroke in these elderly and difficult cardiac surgical patients.

DR. NICHOLAS T. KOUCHOUKOS (Closing Discussion): I'd like to thank Dr. Hudspeth and Dr. Gardner for their comments. Dr. Hudspeth described a series of patients with outstanding results with the use of moderate degrees of hypothermia and without circulatory arrest. We would certainly support this approach. Our approach to patients who do not have severe bilateral disease is the same. That is, we perform the procedure simultaneously using lesser degrees of hypothermia and reduced flow, and our results are comparable. We would agree with him that these procedures are best performed in a single operative period and that they should be performed on cardiopulmonary bypass. With regard to Dr. Gardner's questions, we are comfortable with the use of circulatory arrest. We feel that it is safe for a period of 30 minutes. In patients with severe bilateral disease, the protective effect of the additional period of circulatory arrest we believe is beneficial. It may be possible to do some of these patients with less severe forms of disease without circulatory arrest. We routinely scan patients with the duplex technique who are over the age of 65. Patients who are younger and who have a history of TIA or stroke, who have bruits or evidence of extensive occlusive disease in other systems are also scanned. The issue of what to do with patients who have carotid artery disease is an important one and one that has troubled cardiac surgeons for some time. After we began routine duplex scanning but before we began this study using the combined technique as a routine, we encountered three patients who had severe unilateral carotid disease who were not symptomatic and who were not treated by endarterectomy. We documented the presence by duplex scanning in the postoperative period of complete occlusion of that carotid artery and the development of a severe hemispheric insult. Thus, we believe that high-grade carotid disease can proceed to total occlusion in the perioperative period and be a risk factor for stroke. For that reason, patients with high-grade lesions, irrespective of symptoms, should undergo carotid endarterectomy. The question of accuracy of duplex scanning and relying on the scan as the only indication for operation is an important one. In approximately two thirds of our patients, we confirmed the presence of the stenosis by either MRI imaging or standard cerebral angiography. Unfortunately, many of these patients are very unstable. A large percentage had left main disease and were on nitroglycerin and heparin drips. Conventional angiography carries some risk in such patients. We are confident in the majority of patients, in doing an endarterectomy on the basis of the duplex scan. It is possible that with increasing experience we may reduce the need for a total circulatory arrest in some patients and rely on low flow and profound hypothermia. But I would add that with increasing experience we do not believe that the use of a period of circulatory arrest for 30 minutes has any significant detrimental effects and will continue to use it in the high-risk groups.