generally been that off-pump surgery results in better neurocognitive outcomes than on-pump procedures. Apart from the well-documented role of cardiopulmonary bypass in emboli generation, this finding might be explained by the interesting fact that it is actually the act of aortic cannulation rather than the application of the clamp itself that is likely to generate the greatest number of emboli.⁵ This might explain the better results in the off-pump group and the comparable results in the 2 on-pump groups with different degree of clamp use in this trial, obviating the little additional benefit of reduction in clamp number.

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Reply to the Editor:

The authors of our article thank Omer Ashraf for his comments relating to our published article. We thank him for his careful reading and analysis.

Ashraf makes the comment that it was invalid to compare the multiple clamping group with the single clamping group and the off-pump coronary artery bypass group

because the group is significantly older. As we stated in the "Discussion" section, we have performed additional analyses on patients in all 3 groups who were older than the age of 65 years and found that the multiple clamping group still had a statistically greater number of neurocognitive deficits at 3 and 6 months, thus invalidating this criticism. There was no significant difference between the incidence of hyperlipidemia or atrial fibrillation in all 3 groups.

Relating to late neuropsychologic testing, as mentioned by Ashraf, in our experience deficits that occur after 6 months often appear in a new domain and thus might represent a new brain lesion, usually related to spontaneous atherosclerotic emboli.

Our analysis of the literature would suggest that the question of better neurological or neuropsychologic outcomes with OPCAB surgery has evidenced no clear difference, as did this study. Evidence from our institution would also suggest that the more applications of aortic clamps, cannulas, or proximal anastomoses, the greater number of emboli. The temperature at which those emboli reach the brain is also important in determining outcome.

We thank Ashraf for his comments and appreciate the time spent on the article.

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Redo coronary bypass grafting: Role of arterial grafts and time interval To the Editor:

I read with interest the article by Sabik and colleagues wherein they present their experience with reoperations in bypass surgery.¹ Although the authors have conducted an extensive temporal analysis, some important concerns remain in reference to the implications drawn from this report.

An important factor left unaddressed in this study was the mean time for reoperation. The time between primary and secondary bypass grafting is a determinant not just of reoperation outcome but also of the risk factors and patient characteristics deeming reoperative therapy.² Therefore it

is important to keep in consideration that the risk factors for reoperation shown in this report may not have uniform applicability and may differ for patients undergoing their second bypass at varying times from their first surgery. The patency of arterial and venous bypass conduits similarly is likely to have individual alterations at different points in time from the first operation, illustrating the efficacy of arterial grafts in reducing reoperation rate only beyond a certain time interval from the primary procedure.

The authors in this report, in cognizance with certain trials in the past, advocate extensive use of arterial revascularization to decrease reoperation rate on basis of their findings. However, some amount of conflict prevails on this issue, with a number of studies advocating no additional benefit of using more than a single arterial graft.^{3,4} In fact the reason that authors were unable to document high reoperation rates among patients with multiple arterial grafts may be owing to the notion that such patients are more likely to undergo percutaneous angioplasty intervention rather than a second bypass procedure. It is arguable, thus, that broad use of arterial grafting would prevent future myocardial ischemia in these patients. Even if a small extra degree of reoperative risk was conferred by avoiding use of more than 1 arterial graft, there remains little overall clinical justification for overuse of multiple arterial grafts, bringing into view one of Dr Sabik's own recent reports that reoperation procedures pose little extra patient hazards today.⁵

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More pumps—more questions

To the Editor:

We would like to congratulate Wilhelm and colleagues¹ on their outstanding results concerning long-term survival after the implantation of axial flow left ventricular assist devices (LVADs). Since the worldwide first implantation of the axial flow pump in our institution on November 13, 1998,² followed by implantations in Vienna 1 week later,³ these pumps have increasingly gained acceptance. Long-term LVAD support not only enables patients to be bridged to heart transplantation or recovery but also opens up the opportunity to prolong high-quality life for nontransplant candidates. The article presented also shows that long-term nonpulsatile or less-pulsatile blood flow is not detrimental for the function of the end organs. Our experience with 44 patients who were supported with rotary blood pumps for more than 200 days accords with the results presented by the authors. However, good long-term results can also be achieved with pulsatile systems. Of a total of 110 patients supported with an LVAD for longer than 200 days in our institution, 66 had pulsatile devices. Of these, 3 patients were supported for more than 4 years with the Novacor LVAS and 2 with the BerlinHeart Excor.⁴

During long-term support, appropriate anticoagulation plays a key role for the survival and complication rates. As anticoagulative medication with the rotary pumps, we now administer phenprocoumon with a target international normalized ratio of 2.5, aspirin, and, in patients supported with axial flow pumps, additional clopidogrel according to platelet aggregation tests, taking polymorphism of the platelet GP IIb/IIIa receptors into consideration.⁵ In our opinion the aspirin dose should not exceed 100 mg/d.

We would be interested in the authors' current anticoagulation protocols and whether they used different regimens in patients with different rotary blood pumps. Second,

based on the experience gained in Münster, are there any preferences of pump type for destination therapy?

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Reply to the Editor:

Left ventricular assist device (LVAD) support was originally used to bridge high risk patients to heart transplantation.¹ After increased experience with this therapy showed that the failing native heart may have the potential to recover, LVAD therapy provided the option of weaning selected patients from mechanical support as an alternative to transplantation.² As technology made further progress, the duration of support has increased markedly and paved the way for destination therapy.

Device selection, however, in particular for long-term support, still remains an unresolved question. Most centers have experience with one or two types of devices. Devices are selected on the basis of personal experience. As long as people are satisfied with the devices they are using,

they do not see a reason to change to other systems. Only centers that handle large numbers of patients use a variety of devices, which offers them the opportunity to compare systems. Prospective randomized studies to evaluate different devices for different indications have not yet been performed.

It is of foremost importance that LVADs meet the criteria of long-term reliability and excellent quality of life in addition to the standard requirements of low frequency of infection and thromboembolism. The intracorporeal pulsatile devices such as the Novacor LVAS and the HeartMate I have demonstrated reliability for long-term support.^{3,4} Extracorporeal pulsatile devices such as the Thoratec LVAD and the Berlin Heart Excor also have supported patients over the long term.^{5,6} The introduction of axial-flow pumps revolutionized mechanical circulatory support. Pump size was markedly reduced, which facilitated the implantation procedure. Bleeding and infectious complications became less frequent. Because axial-flow pumps have not been on the market as long as pulsatile devices, their long-term reliability still has to be proved. Some patients were supported for more than 1 year with the DeBakey VAD, the Jarvik 2000, or the Berlin Heart Incor, respectively.⁷⁻⁹ In particular, the Berlin Heart Incor promises good long-term performance because of the magnetic suspension of its impeller, which provides virtually unlimited durability. The longest support period with this device is about 3 years. The design of axial-flow pumps renders the exchange of single parts less invasive than is required for larger pulsatile devices.

Axial-flow pumps appear to provide a better quality of life than pulsatile devices. They are much smaller than intracorporeal pulsatile pumps, which makes them easier to implant in the pericardium. There is no need for placement in the abdominal wall or in the abdomen, which may cause gastrointestinal and digestive complications. In addition, the axial-flow pumps run silently, whereas the clatter of pulsatile devices accompanies the patient and his environment day and night. Extracorporeal pulsatile systems are associated with an additional aesthetic and psychological disadvantage. The pump chambers, which are located permanently outside the body, re-