nulation remains widely accepted and popularized for reasons that remain unclear. This is despite the fact that it is the most “physiologic” approach in establishing cardiopulmonary bypass in acute type A aortic dissection. We have been using this technique exclusively since 1995 for the reasons outlined by Dr Wada and associates. However, we would like to share additional valuable comments that our experience has demonstrated.

Although placement of the aortic cannula through the aortic valve into the true lumen is desirable, it is not essential. In some cases of cardiomegaly we found that the cannula was too short to traverse the aortic valve. The tip was therefore guided into the left ventricular outflow tract under transesophageal echocardiography. We encountered no compromise in perfusion pressures, flow rates, or ventricular distension. Furthermore, although Dr Wada and colleagues suggest that the technique is not practical after previous cardiac surgery, our experience is to the contrary. We recently used the transapical approach in a patient who presented with recurrent type A aortic dissection some years after his initial presentation. The dissection flap involved both femoral arteries and neck vessels, precluding all other sites for extrathoracic cannulation. The left ventricular apex was easily exposed through a small left thoracotomy and a 21F Bio-Medicus cannula (Medtronic, Minneapolis, Minn) introduced through a stab incision. The presence of such patients with no option for extrathoracic cannulation because of extensive dissection is not uncommon, and they would otherwise be denied surgery. However, perfusion of the true lumen can be ensured with the transapical approach.

The theoretic disadvantages to the approach include potential problems with the stab incision repair. Our arterial cannula is designed for percutaneous femoral cannulation and has a rigid sharp introducer. Our stab incision, which measures less than 4 mm, is not full thickness because the myocardium is split along the fibers by the cannula rather than cut by a knife. In our experience the size of the wound is similar to that when an apical vent is used for conventional aortic valve replacement. Because of the small wound size, we do not routinely use pledgets for repair but place a horizontal mattress 4-0 polypropylene suture with an over-and-over running suture.

To date we have encountered no technical difficulty with the repair site.

In conclusion, our experience supports the use of transapical cannulation as the method of choice for arterial inflow in type A dissection. We strongly advocate its routine use and are grateful to Dr Wada and colleagues for confirming it in their large series.

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Reply to the Editor:

We appreciate the comments of Dr Jutley and colleagues concerning our recent article.¹ As they said, transapical aortic cannulation is the most physiologic approach to establish cardiopulmonary bypass in type A aortic dissection.

We would like to give some additional explanation related to their comments. Our cannula is long enough to traverse the aortic valve in patients with cardiomegaly (Figure 1, A). It is necessary that our stab

incision, which measures approximately 1 cm, be full-thickness myocardium because the tip of this cannula is not sharp (Figure 1, B). As a result, we routinely close the incision with a few (usually 3) 4-0 polyvinylidene fluoride interrupted sutures with felt pledgets. There were no bleeding problems after performing stab-wound cannulation and closing the incision with this technique.

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Off-pump coronary artery bypass sacrifices graft patency

To the Editor:

We are grateful to Dr Gardner¹ for his editorial regarding our meta-analysis² of randomized controlled trials of off-pump coronary artery bypass (OPCAB) versus conventional coronary artery bypass grafting (CABG), and we absolutely agree with his statement: “the choice of which technique (of OPCAB or CABG) to use should remain the surgeon’s option.” However, we, in the era of evidence-based medicine, are convinced that the surgeon’s option should be based on the best evidence, such as a meta-analysis of randomized controlled trials (type Ia evidence recommended by the Agency for Health Care Policy and Research).

The meta-analysis of 37 randomized trials (3369 patients) of OPCAB versus CABG by Cheng and associates,³ published in 2005, demonstrated that no significant differences were found for 30-day mortality, myocardial infarction, stroke, renal dysfunction, intraaortic balloon pump, wound infection, rethoracotomy, or reintervention. However, OPCAB significantly decreased arterial fibrillation, transfusion, inotrope requirements, respiratory infections, ventilation time, intensive care unit stay, and hospital stay.³ Therefore, OPCAB

Figure 1. Sarns Soft-flow Extended Aortic Cannula (Terumo Cardiovascular Systems, Corp, Ann Arbor, Mich).

surpasses CABG in these selected short-term and mid-term clinical and resource outcomes. On the other hand, as far as bypass graft patency is concerned, CABG is superior to OPCAB according to several more recent meta-analyses of randomized controlled trials, including our meta-analysis.^{2,4,5} The choice of which technique of OPCAB or CABG to use should be based not on the clinical experiences of respected authorities (type IV evidence) but on the above-mentioned best evidence.

We completely agree with Dr Gardner's statement: "Were it (OPCAB) not for our young colleagues who have championed OPCAB, the option of successfully using this approach when preferable to conventional CABG surgery would not exist today." We emphasize that OPCAB should not be performed when preferable to CABG because OPCAB sacrifices graft patency in such patients as were enrolled in the randomized controlled trials reviewed in our meta-analysis.

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Precise quantification of pressure-flow waveforms during pulsatile and nonpulsatile perfusion

To the Editor:

We would like to congratulate Kassab and colleagues¹ on their experimental design and results concerning pulsatile cardioplegic delivery in improved subendocardial perfusion of the open failing ventricle when compared with nonpulsatile perfusion. We believe that their investigation is a good attempt to use pulsatile flow as a myocardial protective strategy during the cardiopulmonary bypass (CPB) procedure. Such information may be critical to enhance cardioprotective strategies in cardiac patients in the near future.

We would like to make several comments concerning direct comparison between pulsatile and nonpulsatile modes. We believe that it is essential to acquire precise quantification of pressure and pump-flow waveforms during direct comparison between perfusion modes.^{2,3} It is insufficient to use the pulse pressure as the only criteria to define the pulsatile flow, because the generation of pulsatile flow depends on an energy gradient.²⁻⁴ In addition to the pressure waveforms, the pump flow waveforms should also be included in the quantification. The precise quantification of pressure-flow waveforms in terms of hemodynamic energy, energy equivalent pressure (EEP), and surplus hemodynamic energy (SHE) levels is a must. Surplus hemodynamic energy is the "extra energy" generated only under adequate pulsatility.

The EEP formula is based on the ratio between the area beneath the hemodynamic power curve ($\int f p dt$) and the area beneath the pump flow curve ($\int f dt$) during each pulse cycle⁴:

$$EEP = (\int f p dt) / (\int f dt)$$

where f is the pump flow rate, p is the arterial pressure (mm Hg), and dt indicates that the integration is performed over time (t). The unit of the EEP is mm Hg. Therefore, it is possible to compare the EEP with the mean arterial pressure (MAP). The difference between the EEP and MAP is the extra energy or SHE generated by each pulsatile or nonpulsatile device.

In our studies on myocardial flow in direct comparison between two different modes in terms of EEP and SHE, pulsatile perfusion produced significantly higher hemodynamic energy than did nonpulsatile

perfusion during CPB.^{2,3,5} The pulsatile group had significantly better myocardial blood flow than had the nonpulsatile group; particularly, pulsatile flow improved left- and right-ventricular blood flow after 60 minutes of ischemia and hypothermic CPB in a piglet model.⁵ In a recent clinical study, it has also been clearly documented that pulsatile flow resulted in significantly less inotropic support, shorter intubation time, and shorter duration of intensive care unit stay and hospital stay in 50 pediatric CPB patients.⁶

We congratulate the authors for their promising results and strongly suggest that they consider using the EEP and SHE formulas for direct comparisons of pulsatile and nonpulsatile perfusion for their future experiments.

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