Commentary: Cardioplegia solutions for myocardial protection—Dealer's choice

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In this issue of the *Journal*, Vivacqua and colleagues¹ report the results of their randomized trial and demonstrate the noninferiority of a single dose of Custodiol HTK (Essential Pharmaceuticals, LLC, Durham, NC) relative to repetitive cold blood cardioplegia in protecting the myocardium, as measured by postoperative cardiac enzyme leaks. This study adds to the growing literature comparing different types of solutions for myocardial protection.

Myocardial protection is a multifaceted stepwise process. It depends not only on the type of solution used but also on 3 other factors in this simplified conceptual model (Figure 1).

Approach. The approach and temperature of administering cardioplegia, whether it is antegrade, retrograde, or a combination of both, needs to be individually tailored to the patient and operation at hand.² In their current study, Vivacqua and colleagues¹ individually tailored the approach according to the presence of aortic insufficiency. It is unknown whether coronary artery disease or coronary artery bypass grafting influenced their approach, bearing in mind that coronary artery bypass grafting only accounted for 10% of the study population.

Solution. Several observational studies, randomized trials, and meta-analyses have attempted to elucidate which cardioplegia solution provides the best myocardial protection.³⁻⁵ However, the search for the ideal solution continues. The study by Vivacqua and colleagues¹ demonstrated that a single dose of Custodiol cardioplegia solution was not inferior to traditional blood cardioplegia by measuring postoperative cardiac enzymes. The study of Vivacqua and colleagues¹ was modeled after a previously published trial from Norway that showed similar results.³

Time. Even after administering the perfect cardioplegia solution through the perfect approach, it is important to note that the myocardium is still in a period of relative ischemia. Performing an expeditious, efficient, and technically perfect operation becomes of the utmost importance during this period. Vivacqua and colleagues¹ suggest that

Components involved in myocardial protection.

Central Message

Cardioplegia solutions provide clinically similar myocardial protection.

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a single dose of cardioplegia is less disruptive and more efficient for the flow of the operation than repeated dosing. Their data, however, show that the crossclamp times were not different between the groups. On the other hand, repetitive dosing could provide the surgeon with a sense of security by actively protecting the myocardium every 20 minutes. In addition, one might argue that the “surgeon’s mental break” every 20 minutes necessitated by repetitive dosing is beneficial to reset the 20-minute focused attention span of the human brain. It is commonly agreed on (albeit without much scientific evidence) that the selective sustained attention or focused attention, which is the level of attention that produces consistent results on a task with time, lasts as long as 20 minutes. In other words, the repetitive cardioplegia 20-minute interval interruption does not slow down the operation, and it might actually provide the surgeon with both a sense of security and a mental break to refocus on the task at hand. Neither single nor repetitive cardioplegic administration appears to be detrimental.

Reperfusion. The ischemic myocardium is susceptible to reperfusion injury after the release of the crossclamp.⁶ Many surgeons use a controlled reperfusion strategy with warm cardioplegia or a hot shot to limit reperfusion injury and reduce the incidence of ventricular fibrillation while the patient is coming off bypass. The traditional repetitive blood cardioplegia group in this study did not receive controlled reperfusion. Although the incidence of arrhythmias was similar between the groups, it is unclear whether

FIGURE 1. Components involved in myocardial protection.

intraoperative arrhythmia rates were different. Custodiol HTK solution is hypothesized to be associated with a lower incidence of reperfusion injury because of the presence of histidine.

CONCLUSIONS

The study by Vivacqua and colleagues¹ has several limitations. The power calculation that was performed was not congruent with their primary outcome of interest. The groups remained heterogeneous, with underrepresentation of myocardial revascularization operations in the Custodiol group. Finally, the majority of the patients in this study had

preserved ejection fraction. Whether any differences in myocardial protection exist between traditional repetitive cardioplegia and single-dose cardioplegia in patients with low ejection fraction undergoing coronary artery bypass grafting remains unknown. Notwithstanding these limitations, Vivacqua and colleagues¹ are to be commended on conducting this thoughtful trial. It is especially challenging to perform well-conducted noninferiority trials,⁷ especially in the field of cardiac surgery.

Generally speaking, there are 3 missions in cardiac surgery to ensure good outcomes: protect the heart, protect the brain, and perform a technically good operation. To protect the heart, the cardioplegia solution remains a dealer's choice.

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