moral antigens. Conservation of blood during surgery will always be important because of the shortages of donor blood, the risks associated with the use of allogeneic blood products, and the costs of these products.

At this stage, the outcome measured needs to be better studied in a larger group of patients to determine whether a beneficial effect is achieved when the cause is simply a new-onset decrease in hematocrit during CPB that requires the action of blood transfusion.

How Can We Define the Dimensions for Safe Intraoperative Hematocrit Level?

In the context of a study trial, all variables in a scientific study must be controlled except for a single variable that is being studied. This is an incredible task, but it can be solved with a national task force among many regional centers and coordinated in the most organized fashion. Recruitment of centers that are indifferent to institutional experience is key for eliminating bias. The center with established excellence in surgical outcome among The Society of Thoracic Surgeons risk stratification subgroups will minimize technically dependent outcome variables and maximize the weighted effect of a single variable—hematocrit. The patient population description should include elective surgical patients who require primary or redo CPB coronary, valve, or both types of surgery; who lack hematologic causes for anemia; who have a well-defined etiology of disease process; and who lack prior blood transfusions in the last 3 months, including a well-defined level of comorbidity.

Selection of Hematocrits

Given the already available data in the literature, it is important to choose 2 pathways, each performed randomly at each collaborating surgical unit, given that neither the perfusionist nor the surgeon will be blinded. This will mathematically accommodate a range of preoperative hematocrits to better define absolute and relative risk or benefit to the population sample after transfusion or not. The 2 pathways are (1) transfusing for hematocrits below a discrete value (20%, 25%, and 30%) and (2) transfusing for hematocrits when an absolute difference in CPB hematocrits (5, 10, 15,

and 20 integers) is documented during surgery.

The volume of blood transfused should be held constant, and 1 unit of allogeneic blood should be sufficient except in rare circumstances. Should the next hematocrit level respond, no further blood transfusion should be given, yet further transfusion will be given if levels keep decreasing. Time from acknowledging the hematocrit level after the intervention (blood transfusion) will need to be further defined at discussion committees, among other variables, especially regarding triggers for preoperative CPB, postoperative CPB, and intensive care unit periods with respect to 4 important groups of patients—those with left ventricular dysfunction, recent myocardial infarction, congestive heart failure, and incomplete revascularization—because such groups require a higher hematocrit level.

A host of other blood product transfusion, perfusion, and operative variables—including age of blood transfused; priming volume; length of operation; amount of blood transfusion; type of blood transfused (eg, leukocyte depleted, cytomegalovirus status, and allogeneic vs predonated autologous blood); pump run; blood-primed pump; use of preoperative antiplatelets, anticoagulants, and antifibrinolytics; duration of CPB; temperature control (hypothermia and normothermia); volume of crystalloids and colloids infused and reason for infusion; and volume of other blood products infused—will need to be adjusted after consultation with a consortium of perfusionists and hematologists who are experienced in this field.

Also, a similar policy for transfusion should be adopted after surgery to avoid the potential influence of postoperative transfusion on clinical outcome. Outcome, including neurological outcome and survival, should be temporally and qualitatively documented particularly early after surgery and several years later.

Overall, there must be a safe range of hematocrits for each patient in adult and pediatric patients. Available studies remain largely observational and cannot adjust for the effects of all the confounders. In the interim, conservative use of blood products in heart surgery is warranted because of the infectious and non-

infectious complications of allogeneic blood transfusion.

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Reply to the Editor:

We would like to thank Dr Jonas for his comments on our recent article.¹ Our study was a prospective, observational study, and the patients had an uncomplicated course in which the criteria for red blood cell transfusion included anemia with a hematocrit level of less than 15% during bypass and 20% after bypass. Jonas and associates² conducted a randomized study, and they concluded that a higher hematocrit strategy was safe for psychomotor development in infants. Habib and associates³ retrospectively analyzed the surgical outcomes from their 6-year experience and concluded that there was a strong association between severity of hemodilution during cardiopul-

monary bypass and serious complications, particularly when the nadir hematocrit decreased to less than 22%.

In these 3 studies, the age, weight, seriousness of the disease, previous cerebrovascular accident, duration of circulatory arrest, and percentage of emergency surgery were completely different. Therefore, it might be very difficult to compare the results and determine an appropriate hematocrit level during cardiopulmonary bypass, especially for surgical cases using deep hypothermic circulatory arrest. Regarding the backgrounds of the patients, our study group was considered to be the best candidates for hemodilution during cardiopulmonary bypass. Transfusion has been proven to be an effective therapy for hemodilutional anemia. However, this therapy may cause severe adverse effects. Although there were no adverse effects in our study group, we agree with Dr Jonas that a prospective randomized study should be performed not only in adults, but also in children with simple congenital heart defects to determine the appropriate hematocrit level that improves a patient's chance for the most favorable outcome.

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Extrapleural pneumonectomy for malignant mesothelioma: Should pericardium be resected routinely?

To the Editor:

We read with interest the article by Sugarbaker and colleagues¹ in the July issue of the *Journal*. This study reports their extensive experience with the management of complications occurring after extrapleural pneumonectomy (EPP) done mainly for malignant mesothelioma. It is clear from the Sugarbaker article that technical complications might arise from the resection and replacement of the pericardium with a patch, such as size mismatch, improper insertion and suturing, or inadequate fenestration. Three percent of their patients had cardiac arrest, 2.7% had constrictive physiology caused by inflammatory epicarditis, 3.6% had tamponade, and 44.2% had atrial fibrillation.

Although we recognize the importance of Sugarbaker's work in studying specific complications of EPP and reporting the largest series to date, we would like to emphasize a particular technical point that might prove useful in some patients. Recently, we have been surprised that some patients with stage I or II malignant mesothelioma receiving induction chemotherapy before EPP presented at the operation with a pericardium macroscopically free of disease. In those patients we have taken random biopsy specimens of the pericardium and have preserved them. Histopathology confirmed the absence of pericardial invasion in all patients. In such patients with a macroscopically normal pericardium, we suggest taking frozen sections of the pericardium and preserving them if the frozen sections are negative. Although we do agree that pericardium has to be resected in most patients with malignant pleural mesothelioma, it is likely that with the adoption of induction chemotherapy before EPP² and refinement of diagnostic techniques, such as positron emission tomography and computed tomography, more patients will be operated on with the possibility of preserving their native pericardium, thereby reducing the incidence of cardiac complications, reducing the operative time, and facilitating the anchorage of the diaphragmatic patch.

We would also like to mention that chylothorax is another potential complication of EPP, with a recent article reporting an 18.7% incidence.² Although no postoperative chylothorax has been reported in the series by Sugarbaker et al,¹ we would like

to re-emphasize the importance of prophylactic thoracic duct ligation during right-sided procedures.

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Reply to the Editor:

The primary goal of extrapleural pneumonectomy in mesothelioma is to perform a complete macroscopic cytoreduction. Routine pericardiectomy is an important step in achieving this goal. The issue of pericardial resection and reconstruction from the morbidity standpoint is a higher atrial fibrillation rate, the risk of cardiac herniation from a poorly constructed patch, tamponade from a tight patch, and epicarditis.

Our high rate of atrial fibrillation compared with that seen in other reports that use similar resection of the pericardium stems from our policy of monitoring all patients with telemetry until discharge from the hospital. Opening the pericardium is only one of the multiple causes of atrial fibrillation. Entry into the pericardium with multiple random biopsies would also result in a higher atrial fibrillation rate or at least not a significant decrease in those rates.

Cardiac herniation or tamponade from a poorly done pericardial reconstruction would be avoided by not resecting the pericardium. These are not common events, however, and were more prevalent during our earlier experience. However, from an oncologic perspective, it would not be prudent to risk a good cytoreduction, even in the setting of a few negative random biopsy specimens. It is this group of patients with early disease that would benefit the most from the most aggressive surgical intervention.