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In Reply:—Inchiosa and colleagues suggest that the percentage change (in contrast to the absolute change) in regional myocardial contraction during a decrease in afterload is greater in postischemic regions than in control regions. We have performed the paired statistical comparison requested, and it yielded no firm support for this conclusion. The calculation of percentage change in thickening as mean arterial pressure decreases from 110 to 70 mmHg involves small and, in some cases, negative numbers in the denominator. The resulting ratios are not normally distributed and thus violate the assumptions of a paired *t* statistic. The nonparametric analog, the sign test, was nonsignificant.

Although the statistics are inconclusive, the concept proposed by Inchiosa and colleagues seems valid. A change in a small number seems larger than the same absolute change in a large number. At issue, however, is interpretation rather than validity of the data. Patients with diseased hearts may, in fact, like to hear that their exercise tol-

erance has doubled from three steps to six with afterload reduction therapy. We prefer to think in absolute terms.

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Prevention of Venous Air Embolism Related to Veno-venous Bypass during Orthotopic Liver Transplantation

To the Editor:—Although veno-venous bypass has been reported to decrease the morbidity and mortality associated with orthotopic liver transplantation (OLT),¹ venous air embolism has been described during veno-venous bypass using opaque, heparin-bonded tubing.² For this reason, clear polyvinyl tubing has been recommended,³ allowing visual assessment of air in the system as well as an automated air detector. We report a case in which venous air embolism related to veno-venous bypass during OLT was prevented by the use of clear polyvinyl tubing.

A 9-yr-old, 17-kg boy with biliary atresia was scheduled for reduced-size OLT from a living related donor. Anesthesia was induced with isoflurane and was maintained with isoflurane and fentanyl. Muscle relaxation was achieved with vecuronium, and the lungs were mechanically ventilated. Systemic arterial pressure (SAP), pulmonary arterial pressure (PAP), central venous pressure (CVP), ECG, peripheral hemoglobin oxygen saturation, and inspired and expired carbon dioxide tension were monitored.

Despite the loss of 4,000 ml blood loss during the 6 h of dissection, the patient was hemodynamically stable prior to venous bypass (SAP 120/70 mmHg, PAP 25/10 mmHg, and CVP 10 mmHg). The bypass circuit consisted of a Biomedicus model 520 console and a model 50 Bio Pump (48 ml volume) and clear polyvinyl tubing of 9.5 mm internal diameter. The bypass circuit was primed with lactated Ringer's solution without heparin. Cannulas, connected to pump tubing, were inserted into bilateral femoral veins, the portal vein, and the left axillary vein.

Immediately after the initiation of veno-venous bypass, air bubbles were noted in the inlet cannula from the portal vein. The bypass pump was stopped, and a large amount of air was noted to be present in the pump head and inlet tubing, but not in the outlet tubing. SAP, PAP, CVP, and end-tidal carbon dioxide tension were unchanged.

The ligature around the portal vein cannula was noted to be loose, resulting in air entrainment. After reestablishment of the connection of the portal vein and disconnection of the outlet tubing from the axillary cannula, the entrained air was evacuated extracorporeally from the pump head with drained blood using the pump force. The 1,000-ml blood loss sustained during this procedure resulted in a decrease in SAP to 70/40 mmHg, but infusion of stored blood promptly restored normotension. After evacuation of air from the pump system, veno-venous bypass was instituted without further incident. The patient was discharged from the hospital 8 weeks later without neurologic, cardiac, or pulmonary sequelae.

We believe this case demonstrated that the use of clear polyvinyl tubing adds significantly to patient safety during veno-venous bypass. Surgeons must take special care to ensure that the cannulae connections are air-tight, and anesthesia personnel must continuously monitor tubing for entrained air.

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