nally, how do patients feel about costs? How many potential transplant recipients have no medical insurance or prescription coverage for costly immunosuppressive medications?

The combination of the physiologic studies and survival data in the medical literature with the new quality of life data from Gross et al. strongly supports continued efforts in lung transplantation. Lung transplant centers worldwide are currently directing major research efforts at diagnosing, treating, and preventing OB. At the same time, transplant centers have realized the importance of providing support groups, physical rehabilitation, nutritional counseling, psychotherapy, and even career guidance to improve medical and nonmedical quality of life after lung transplantation.

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Is Mouth-to-Mouth Ventilation Necessary for Successful Resuscitation?

For over 30 years, emergency ventilation has been considered an indispensable element of cardiopulmonary resuscitation (CPR). There is renewed debate, however, about the need for ventilation during basic life support CPR. In part, the catalyst for this debate is fear of transmitting contagious diseases. Because of this fear, both lay and professional rescuers are reluctant to perform mouth-to-mouth ventilation. Therefore, research that clarifies when emergency ventilation is necessary is important because rescuers might be more willing to perform chest compressions if mouth-to-mouth ventilation were unnecessary.

Evidence is increasing that ventilation can occur through a number of distinct mechanisms during cardiac arrest and CPR. For example, with chest compression, change in intrapleural pressure is sufficient to move gas in and out of the lungs and thus can provide some gas exchange. Another mechanism of ventilation was shown in swine and rodents: spontaneous gasps. During cardiac arrest both frequency and depth of gasping correlated directly with successful resuscitation. Although there are few studies of the efficacy of ventilation during cardiac arrest in humans, in one study from Seattle, spontaneous agonal respiratory efforts immediately after cardiac arrest were associated with a higher rate of successful resuscitation.

Before the rediscovery of mouth-to-mouth ventilation in the 1950s and 60s, manual techniques of ventilation were used widely for rescue breathing. The principal advantage of mouth-to-mouth ventilation is that an integral part of it is maintenance of upper airway patency. In this issue of CHEST, Fukui and coworkers (see page 1663) report that, in a rodent model of cardiac arrest, upper airway patency is important for gas exchange during chest compressions. In this model, positive pressure ventilation was not used, but ventilation did occur during spontaneous gasping and also possibly secondary to chest compression. When airway patency was protected with an oropharyngeal device, spontaneous gasping was more than twice as frequent and arterial oxygen saturation higher than without airway protection. Nevertheless, return of spontaneous circulation and 24-h survival did not differ between the two groups. The study suggests that, at least in some animals, spontaneous gasping during cardiac arrest was associated with maintenance of some upper airway tone and patency. It also shows that gasping and gas exchange are improved when airway patency is protected.

Despite any limitations in this study, how does it relate to CPR in humans? Ventilation by spontaneous gasping has some advantages over mouth-to-mouth ventilation. Compared with air, the gas given during mouth-to-mouth ventilation has much more CO₂ (4%) and less O₂ (16%), which may affect resuscitation adversely, while gas inhaled during spontaneous gasping has virtually no CO₂ and 21% O₂. Mouth-to-mouth ventilation uses positive pressure, which is associated with gastric inflation, regurgitation, and aspiration; inhalation during spontaneous gasping occurs during negative upper airway pressure, which prevents gastric inflation. Finally, transmission of contagious diseases by spontaneous gasping is unlikely.

Whether humans gasp as frequently and as deeply as healthy animals during cardiac arrest and whether
the upper airway remains unobstructed are unknown. Because the study by Fukui et al shows improved oxygenation and ventilation when the upper airway was patent, assuring an unobstructed airway should remain a high priority during basic life support. For now, CPR instruction should recommend that, when a victim is gasping spontaneously, if the rescuer is unwilling to perform mouth-to-mouth ventilation, then, at the very least, upper airway patency should be maintained by conventional means in addition to chest compression. The study by Fukui et al is an important contribution to the growing body of medical literature on ventilation during cardiac arrest. Many questions in this crucial area, however, remain to be answered by future research.

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The Gastrointestinal Tract and Critical Illness

Is More Perfusion Better?

The gastrointestinal tract has long been known to be particularly sensitive to alterations in regional blood flow that result from critical illness. Gastrointestinal ischemia has been implicated in the pathogenesis of multiple systems organ failure (MSOF). The ischemia has been postulated to result in a permeability defect allowing translocation of bacteria and bacterial products into the portal circulation. Inadequate liver perfusion causes hepatocyte and Kupffer cell dysfunction interfering with the clearance of bacteria and their products. The systemic inflammatory response syndrome with eventual end organ damage is the final outcome. Shock can usually be diagnosed at the bedside by hypotension, altered mental status, reduced urinary output, and lactic acidosis. More subtle organ ischemia, however, may go undetected. For some time, intensivists have searched for a measure of the adequacy of oxygen delivery at the cellular level. The Swan–Ganz catheter gives a rough estimate of global oxygen delivery, but it sheds little light on the adequacy of oxygen delivery to specific organs and cells. Gastric tonometry was developed in an attempt to diagnose occult gastrointestinal ischemia. A saline filled balloon inflated in the stomach is thought to be a tonometer that provides a reasonable estimate of the PCO2 in the wall of the stomach. This PCO2 and the arterial bicarbonate level are then used in the Henderson–Hasselbalch equation to calculate "intramucosal pH" (pHi). The utility and role of pHi in diagnosing gastrointestinal ischemia remains controversial.

In this issue of CHEST, Maynard and colleagues (see page 1648) evaluated the effect of low dose dopamine and dopexamine in critically ill patients with low pHi determined by tonometry. Gastric tonometry, monoethylglycinexylidide (MEGX) formation from lidocaine, and indocyanine green (ICG) plasma disappearance were evaluated. pHi was used as a measure of gut perfusion. Both systemic ICG clearance and MEGX formation from lidocaine are predominately flow-dependent and thus estimate hepatic blood flow. During low dose dopexamine infusion, pHi rose from 7.23 to 7.35 (p<0.005), the median ICG plasma disappearance rate increased from 7.6 to 11.3%/min (p<0.02), and the median MEGX concentration increased from 4 to 10.2 ng/mL (p<0.005). No such effect was seen with low dose dopamine. Their results suggest that low dose dopexamine, but not low dose dopamine, improves splanchnic and hepatic blood flow without any measurable systemic hemodynamic ef-