Clinical and hemodynamic comparison of 15:2 and 30:2 compression-to-ventilation ratios for cardiopulmonary resuscitation.

Abstract: In its most recent revision of the ACLS guidelines, the American Heart Association recommends a compression-to-ventilation ratio of 30:2 for the resuscitation of victims of circulatory arrest, from infants to adults. It is difficult to design clinical trials in order to fine-tune resuscitation strategies, so controlled laboratory tests with experimental animals are important. Yannopoulos et al. describe a pig model that supports the 30:2 ratio and also supports their ingenious airway device as an aid to resuscitation.

The animals were subjected to 6 min of no-flow ventricular fibrillation followed by 10 min of closed-chest CPR with a compression-to-ventilation ratio of 15:2 or 30:2. An impedance threshold valve was added to the breathing circuit in both groups after 6 min of CPR (12 min of ventricular fibrillation). The impedance threshold valve is designed to impede inspiration of gas during elastic recoil of chest and, hence, to increase the negative intrathoracic pressure and the venous return to the heart. The acid-base status, cerebral and cardiovascular hemodynamics were monitored or calculated in all animals. The authors found significantly improved diastolic blood pressure, coronary perfusion pressure, and common carotid blood flow in the animals randomized to 30:2 compression-to-ventilation ratio. End tidal CO2 was greater in the 30:2 CPR group, but arterial pH did not differ between the groups. Most importantly, the authors report successful return of spontaneous circulation in 6 of 9 animals in the 30:2 CPR group, versus 1 of 9 in the control group.

In human studies, the authors evaluated fatigue and quality of CPR for 5 min of 15:2 or 30:2 on a recording manikin. No differences were observed between the groups in the quality of CPR performance.

Comments: The rationale for the 30:2 compression-to-ventilation ratio is to ensure delivery of longer series of uninterrupted chest compressions. Uninterrupted sequential chest compression generates better vital organ blood flow, and hence improves the chance of successful resuscitation. The Yannopoulos paper demonstrates improved hemodynamics and survival with a 30:2 ratio and no significant adverse effects on the respiratory parameters.

A survival rate of 67% after 10 min of cardiac arrest without pressors or other aids to improve the blood flow generated by chest compressions is impressive. Even though successful restoration of spontaneous circulation has been reported in animal models of CPR after longer arrest times, pharmacological or mechanical techniques have always been used to improve vital organ blood flow. In fact, without pressors or other mechanical aids in the current study, only 1 of 9 animals survived after 10 min of 15:2 CPR. The significance of the difference between the groups was corroborated by hemodynamic and biochemical differences during CPR.

The authors not only decreased the ventilations per compression, they also applied an experimental inspiratory impedance valve to the airways of the animals. The valve improved hemodynamics with either compression: ventilation ratio. The valve is simple and portable and applies an impedance of -40 cm H2O pressure during chest recoil after each chest compression. It can be used with either an endotracheal tube or else with a well fitting face mask. By inhibiting airway gas entry during elastic recoil of the chest, it improves the effect of negative intrathoracic pressure on venous return. It is likely that future ACLS guidelines will commend the use of the “inspiratory threshold device” in resuscitation.