EDITORIAL VIEWS

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Field Evaluation of Experimental Cardiopulmonary Resuscitation Techniques

THE recommended technique of cardiopulmonary resuscitation (CPR) has changed minimally since the 1960s.[1] It is intuitive that intermittent positive pressure ventilation should be provided to facilitate the elimination of carbon dioxide and the maintenance of oxygenation while the restoration of spontaneous circulation is attempted. In this issue of ANESTHESIOLOGY, Saïssy *et al.*[2] present data suggesting that "breathing," in the classic sense, may not be necessary or desirable during CPR. Furthermore, they suggest that the application of continuous tracheal oxygenation insufflation may provide an alternative to traditional mechanical ventilation. In so doing, the authors provide solid evidence that standard CPR methods provided in out-of-hospital settings show a disappointing success rate (100% mortality in 1 week for a group of patients with asystolic arrests) and that the application of experimental (laboratory) data to the human clinical arena may be warranted. Saïssy *et al.*[2] delivered continuous insufflation of oxygen, which produced continuous positive airway pressure, during precordial compressions. They found that the combination of continuous positive airway pressure and chest compressions during CPR provided gas exchange equivalent to that provided by conventional intermittent positive pressure ventilation. Each technique provided equivalent success, which was measured by the number of patients with spontaneous return of cardiac activity. All patients received significant amounts of intracardiac and intravenous epinephrine, which are proven to cause disruption of ventilation-perfusion relationships and profound postresuscitation arterial hypoxemia.[3] The replacement of intermittent positive pressure ventilation by the continuous insufflation of oxygen may have attenuated the development of ventilation-perfusion mismatching, based on results of arterial blood analysis. Of interest is the authors' presentation of blood gas and oxygen saturation values, which illustrates the inappropriateness of using arterial oxygen tension as a reflection of pulmonary function when intrapulmonary shunting is greater than 20% of cardiac output. Arterial oxygen tension and arterial oxygen saturation have a nonlinear relation secondary to the oxyhemoglobin dissociation curve. This relation is shown by the typical large standard deviation of oxygen tension values, which may skew data and foster misrepresentation (minimization) of the magnitude of pulmonary dysfunction. Use of the arterial oxygen saturation value is desirable not only for the assessment of oxygen delivery, but also for the analysis of pulmonary function.

Temporal aspects of this project are of interest. A specialist physician was at the scene of the cardiac arrest within 10 min—an unlikely scenario in the United States. This aspect illustrates a classic philosophical difference of opinion regarding optimal emergency care. Should the patient be transferred promptly to the well-equipped specialty institution or should specialty care be made available at the scene to stabilize the patient before transportation, even if that care causes delays in the hospital-based diagnostic and therapeutic interventions? The average time from cardiac arrest to restoration of spontaneous cardiac activity was more than 25 min in both treatment groups. Although the early application of advanced cardiac life support, including electric shock and drug therapy, is a key to improved survival in any setting; optimizing the techniques of artificial ventilation and circulation also are important. It is reasonable to speculate that enhanced oxygen delivery and carbon dioxide removal during this critical time may improve survival and quality of life for survivors.

The issue of human research ethics is raised when performing randomized trials on patients who are unable to provide consent and when obtaining approval from next of kin is not possible. Extensive animal studies have investigated alternative methods of providing gas ex-

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change during CPR.[4-8] Some of these novel approaches were successful in replacing intermittent positive pressure ventilation with other means of manipulating airway pressure. Saïssy *et al.*[2] evaluated an experimental approach for ventilation in humans with asystole or severe bradycardia who were undergoing CPR in the field. Because asystole usually is fatal, it is not likely that these patients were harmed by participation in this research study. However, conducting a similar human study probably would not be possible in the United States.[9]

French law allows research to be conducted without consent from the patient or the next of kin in emergency situations. The French equivalent of the American institutional review board is a committee that operates independently but is loosely associated with university hospitals. In cases in which patients are unable to give consent, French law allows, in the case of emergency situations (and only in such cases), research to be conducted in individual patients without patient or family consent. The committee is empowered to approve a protocol to be performed anywhere in France (in specified centers) (Personal written communication to the editorial office, Iowa City, Iowa, from Laurent Brouchard, December 1999). This system reflects the progressive philosophy of acting for the "greater good" and without sacrificing an individual's interest, when a clinical decision is to be made on behalf of an incapacitated patient and when there is reasonable evidence that deviation from the conventional treatment may be beneficial to the patient while furthering science. A comparable decision would be more difficult to make in the United States, where any deviation from the community standard carries tremendous liability, even if the use of the new regimen is supported by extensive laboratory research. Standard care, even if known to provide little chance of survival, becomes the care of choice, not because it will optimize outcome, but because it protects the subjects "rights" as an individual and maintains their status as a "subject" rather than an "object" of the investigation.[10] Hence, more promising, albeit "experimental" forms of therapy are denied to the patient. Maintenance of the status quo also protects the caregiver from liability because an expected poor outcome is easier to defend than the possibly premature application of promising, but new, approaches.

For more than a decade, numerous alternatives to the recommended standard of ventilation during CPR have been advanced in the experimental research literature. Few investigators have performed controlled trials with human subjects. Replicating experimental CPR research in a clinical or field setting poses significant ethical and liability concerns; however, progress in clinical medicine is impossible without taking this crucial next step.

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