Recue ventilation has always been an integral part of both basic (BLS) and advanced (ACLS) cardiac life support. Despite 5 decades of continuous attempts to improve training in cardiopulmonary resuscitation (CPR), maintenance of free airways and adequate ventilation continue to be difficult skills to acquire and maintain for both lay persons and professionals. Because of airway problems and excessive inflation pressures, much of the air enters the stomach instead of the lungs during bystander CPR, and in a recent study, 39% of patients receiving mouth-to-mouth ventilation had signs of regurgitation at the time of intubation.3

Bystander CPR increases overall survival in the great majority of clinical studies, but as suspected, the quality of the bystander effort is important. Poor-quality CPR did not increase survival compared with no CPR in 3 clinical studies. In addition, although the frequency of bystander BLS is as high as 50% to 60% in areas with a long-standing tradition in lay-person CPR training and performance, others report much lower and falling frequencies. This is at least partly due to rescuers’ reluctance to perform mouth-to-mouth ventilation because of fear of disease transmission or esthetic reasons.

Adding the difficulty of instructing ventilations over the telephone, Hallstrom et al conducted a randomized study of emergency dispatch telephone instruction in BLS with or without mouth-to-mouth ventilation with 14.6% survival for compressions only versus 10.4% for standard BLS (P=0.18).

In parallel, the CPR research group at the University of Arizona has over the last 15 years conducted a series of studies on the efficacy of chest compressions only versus standard CPR in pigs. The group consistently report better hemodynamics and equal or better outcome with chest compressions only than with standard BLS with 15:2 compression-to-ventilation ratio.

In the 2005 AHA Guidelines, the compression-to-ventilation ratio for BLS was changed to 30:2 on the basis of new information that lay persons required 16-second breaks in chest compressions to provide 2 ventilations on manikins and that even professionals provided chest compressions only half the duration of out-of-hospital ACLS. This finding indicated that too much time was spent without cerebral and myocardial circulation during CPR.

In the present issue of Circulation, the Tuscan, Ariz, group extends its series of porcine studies to comparing chest compressions only to 30:2 compression-to-ventilation ratio BLS. The group used 16-second breaks in chest compressions to provide the 2 breaths and studied 3 to 6 minutes of untreated ventricular fibrillation followed by 9 to 6 minutes of BLS for a total of 12 minutes, followed by ACLS. Neurological survival 24 hours after arrest was significantly better with continuous chest compressions without active ventilation. This result comes on top of the recent epidemiological study from the SOS-KANTO group in which patients with witnessed cardiac arrest receiving chest compressions only from bystanders tended to have better 30-day survival with favorable neurological outcome than patients receiving conventional BLS (6% versus 4%; P=0.1459).

For the subgroup with ventricular fibrillation or tachycardia, the difference was significant (P=0.041).

Most of these developments point in the direction of abandoning ventilation during lay-rescuer BLS, at least for bystander-witnessed cardiac arrest, as suggested in an editorial in Lancet. But are we there yet? Maybe not quite. Some methodological limitations are inherent in almost all the porcine studies from Arizona, as pointed out by the authors. In all but 1 study, pigs receiving chest compressions only had open endotracheal tubes, which in 1 study resulted in 6- to 8-L/min ventilation in 35-kg pigs because of a combination of gasping and passive ventilation secondary to the chest compressions, with mean PO2 maintained >60 mm Hg and PCO2 <40 mm Hg. In the present study, ventilation volumes are not reported, but ventilation in the pigs receiving chest compressions only was so effective that mean arterial PO2 and PCO2 levels were virtually identical to those in pigs receiving standard BLS. Thus, it was as expected that neurological outcome was better with continuous chest compressions than with standard BLS. Anything else would have been difficult to explain. The arterial oxygen content was the same in both groups, and 1 group had continuous cerebral and myocardial circulation whereas the standard BLS group was without chest compressions half the time.

How realistic is this “realistic swine model of out-of-hospital cardiac arrest”? It is probably realistic in terms of timing and gas mixture and probably less realistic in terms of airways and gasping. Pigs are well known to continue very frequent gasping during good-quality CPR. In the SOS-KANTO study, the frequency of gasping at the time of
emergency medical services arrival was 11% with bystander CPR and 6% without, with no information on the rate. 

Idris et al\textsuperscript{21} paralyzed pigs to avoid gasping during CPR after 6 minutes of untreated ventricular fibrillation and reported low mean arterial Po$_2$ of 38 mm Hg and high Pco$_2$ of 62 mm Hg after 9 minutes of chest compressions only. In that study, survival was significantly worse with chest compressions only than with standard BLS.

The late Peter Safar was adamant that ventilation must continue to be included in bystander BLS.\textsuperscript{24} He argued that in the absence of an endotracheal tube supine, unconscious humans with the head in neutral position have an obstructed airway, contrary to pigs and dogs,\textsuperscript{25} and when using a spirometer accurate for tidal volumes $>$20 mL, he found no detectable tidal volume in 30 subjects secondary to chest compressions versus a mean of 156 mL with an artificial airway in place.\textsuperscript{26} In a recent study of 17 cardiac arrest victims with endotracheal tubes in place, Daekin et al\textsuperscript{27} reported median tidal volumes of only 41.5 mL secondary to 1.5- to 2-in mechanical chest compressions, one-fourth the patients’ median dead space. It should be noted that this study was conducted 40 to 50 minutes after arrest with a likely decrease in respiratory system compliance, and no patient gasped. Dorph et al\textsuperscript{28} studied 30:2 chest compression-to-ventilation ratio and continuous compressions without active ventilation in a porcine model with simulated airway obstruction for passive inhalation secondary to chest decompressions during CPR. In this model, arterial blood was virtually desaturated after a few minutes of ideally performed continuous mechanical chest compressions without ventilation, and return of spontaneous circulation was achieved more rapidly when ACLS was initiated after 10 minutes of standard BLS than after chest compressions only.

The tendency to improved outcome with chest compressions only versus standard BLS in the 2 clinical studies cited above was not significant.\textsuperscript{7,21} The Japanese study was not randomized, with significant confounding factors such as an unequal fraction of off-duty medical workers in the 2 groups. This might have affected the results, and the ventricular fibrillation/ventricular tachycardia subgroup with improved outcome cannot be identified by lay rescuers.\textsuperscript{29}

More epidemiological studies are in the pipeline, and we eagerly await the results. The clinical studies published so far strongly indicate that continuous chest compressions without ventilation are at least not worse than standard BLS, at least for patients with cardiac cause of the arrest.\textsuperscript{7,21} This indication should create the basis for initiating larger, well-controlled clinical trials comparing chest compressions with or without mouth-to-mouth ventilation, as suggested 10 years ago by a working group of the AHA.\textsuperscript{2} At the same time, it is important to remember that many patients such as children and victims of intoxications or near-drowning have a primary respiratory problem. With or without cardiac arrest, they do not have the same intact oxygen stores in the lungs and blood as patients with cardiac cause of the arrest. In some areas, the number of young patients with drug overdose, who require assisted ventilation only, is much higher than the number of patients with cardiac arrest. Mouth-to-mouth ventilation must not be a forgotten art.

Recognizing the difficulties in guideline implementation, there has been a strong attempt to simplify the CPR guidelines.\textsuperscript{1} Removing ventilation from BLS in witnessed cardiac arrest would greatly simplify the treatment of these patients, but will it result in confusion on a higher level? Can lay persons be expected to remember what patients to give chest compressions only and who still requires mouth-to-mouth? We sorely lack good studies on the implementation of guidelines and protocols, not only on this topic but in general and for professionals. Recognizing this, the National Institutes of Health just conducted its first conference on Building the Science of Dissemination and Implementation in the Service of Public Health.\textsuperscript{30}

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References


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Does Active Rescuer Ventilation Have a Place During Basic Cardiopulmonary Resuscitation?

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