Mouth-to-Mouth Ventilation During Cardiopulmonary Resuscitation: Word of Mouth in the Street Versus Science

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In this issue of Anesthesia & Analgesia, Oschatz et al. (1) report that when lay bystanders in Vienna, Austria performed mouth-to-mouth ventilation in cardiac arrest victims before professional paramedics administered advanced cardiac life support, serious ventilation-related adverse effects such as pulmonary aspiration occurred no more often than in patients who collapsed in the presence of professional paramedics, and who therefore received advanced cardiac life support only. Without a doubt, the two most interesting questions raised by this article are the following: why did lay bystander mouth-to-mouth ventilation not increase the ~15% rate of stomach inflation? And why did professional paramedics not achieve a rate of stomach inflation less than ~15%?

When the airway is unprotected, the distribution of ventilation volume between lungs and stomach depends mainly on variables such as lower esophageal sphincter pressure (2), airway resistance, and respiratory system compliance (3). Of equal importance are differences in technique applied while performing basic or advanced airway support, such as head position, tidal volume, inflation flow rate, and duration, all of which determine upper airway pressure (4). The combination of these variables determines gas distribution between the lungs and the esophagus and, subsequently, the stomach. There are several fundamental differences between these components of respiratory mechanics in a healthy, awake patient, an anesthetized supine patient, and a victim of cardiac arrest (Table 1). On the basis of these measurements, we evaluated simulated basic life support ventilation in both bench models and apneic patients and found that even experienced paramedics and anesthesiologists can cause stomach inflation when performing routine bag-valve-mask ventilation (5,6). Moreover, we found that mouth-to-mouth ventilation skills in first-year medical students (who may be somewhat comparable to lay bystanders) deteriorated within 6 mo to levels that did not ensure proper basic life support ventilation performance at all (7).

Extrapolating these observations, patients who received mouth-to-mouth ventilation by lay bystanders in the city of Vienna, Austria (1), would be expected to have much more frequent rates of stomach inflation and pulmonary aspiration, especially when considering that mouth-to-mouth ventilation was performed for approximately 7 min. In fact, our bench model investigations showed severe levels of stomach inflation when basic life support ventilation was simulated in an unintubated cardiac arrest patient for this duration (8). There could be a number of explanations for this discrepancy. First, stomach inflation and/or pulmonary aspiration may have occurred without being detected on chest radiograph; second, mouth-to-mouth ventilation skills were better than we thought; and third, stomach inflation may have been self-limiting (9). None of these possibilities can be ascertained or discounted by the investigators of the present article. Moreover, the authors correctly identified the limitation that only surviving patients were examined, indicating the possibility that if lay bystanders had performed nonsurvivable patients were examined, indicating the possibility that if lay bystanders had performed nonsurvivable basic life support maneuvers, these catastrophic complications would not have been detected as a result of the study design. Although speculative, an additional possibility may be the most likely underlying reason for the observations of Oschatz et al. (1) in Vienna. When paramedics performed bag-valve-mask ventilation, inspiratory times were ~0.5 s instead of 2 s (10), indicating that rescuers may squeeze a self-inflating bag in such a rapid and powerful manner that extremely high flow rates are produced, and subsequently, high peak airway pressures with stomach inflation are very likely. However, it seems obvious that when bystanders perform mouth-to-mouth ventilation, they have less muscle power in their cheeks than paramedics can exert with their hands during bag-valve-mask ventilation, which may result in lower inspiratory flow rates, lower peak airway pressure, and lower rates of stomach inflation. This could explain why lay bystanders did not cause more stomach inflation and/or pulmonary aspiration in the Bystander Ventilation group and why paramedics caused more stomach inflation and/or pulmonary aspiration than anticipated.
in the group given only advanced cardiac life support ventilation. It is surprising that, in the Early Defibrillation group, 2 of 18 patients suffered from pulmonary aspiration despite assisted ventilation not being performed and rapid defibrillation resulted in an almost immediate return of spontaneous circulation. Although a detailed medical history for these two patients was not available, a decreased lower esophageal sphincter pressure, such as in patients with regurgitation and/or hiatus hernia, may have been present.

An expert panel on cardiopulmonary resuscitation (CPR) questioned the need for ventilation during the initial management of human cardiac arrest in 1992 and again in 1997 (11,12). This is an important issue to ongoing discussion and/or hiatus hernia, may have been present.

The new international CPR guidelines of both the American Heart Association and the European Resuscitation Council state that mouth-to-mouth ventilation is safe and may well be lifesaving. Further, reluctance to perform mouth-to-mouth ventilation should be performed in cardiac arrest victims whenever possible. It is both surprising and disappointing that immediate efforts of the resuscitation community to clarify this issue were not printed by the *Frankfurt General Newspaper*, therefore giving the public a skewed impression of how to perform lifesaving maneuvers correctly. This is even more disappointing in view of the fact that lay bystanders in Vienna did not cause more pulmonary aspiration than experienced professional paramedics (1). Thus, lay rescuers should be confident in the knowledge that mouth-to-mouth ventilation is safe and may well be lifesaving. Furthermore, reluctance to perform mouth-to-mouth ventilation is not an important issue in most cases because most cardiac arrests of cardiac etiology occur at home in the presence of family or friends. Lack of training and confidence, poor retention of skills and knowledge, and questionable teaching methods and recommendations may be the main causes of the disappointingly low rates of bystander CPR worldwide. This situation cannot necessarily be improved by simply eliminating a life-saving component of CPR–ventilation and oxygenation (18).

### Table 1. Rescuer and Patient Variables Affecting Respiratory Mechanics During Mouth-to-Mouth Ventilation and Bag-Valve-Mask Ventilation

<table>
<thead>
<tr>
<th>Rescuer</th>
<th>Patient</th>
<th>Conscious</th>
<th>Anesthetized</th>
<th>Cardiac arrest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chin support</td>
<td>LESP (cm H₂O)</td>
<td>~20–25</td>
<td>~20</td>
<td>5?</td>
</tr>
<tr>
<td>Tidal volume</td>
<td>Cₚₛ (mL/cm H₂O)</td>
<td>~100–150</td>
<td>~50</td>
<td>~20–50</td>
</tr>
<tr>
<td>Inflation time</td>
<td>Rₐₚ (cm H₂O · L · sec⁻¹)</td>
<td>~2–4</td>
<td>~15</td>
<td>?</td>
</tr>
<tr>
<td>Ventilator setting</td>
<td>Self-inflatable bag size</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LESP = lower esophageal sphincter pressure; Cₚₛ = compliance of the respiratory system; Rₐₚ = airway resistance.

### References


