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Chest compression-only for cardiac arrest?

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Basic life-support for the treatment of cardiac arrest has long been regarded as comprising both chest compression and assisted ventilation. Recently, however, the benefit of ventilation administered by lay persons has been questioned; some recommend that training in this component be given only to healthcare professionals. The arguments relevant to this controversy are reviewed, together with the reasons that have led to increasing emphasis on compressions for all responders, both lay and professional.

External chest compression for the treatment of cardiac arrest is not new. It was described and used successfully in the nineteenth century, but became widely known only in 1960, when Kouwenhoven and colleagues [1] reported that 14 out of 20 hospital patients had survived after its use; they added that, to initiate cardiac resuscitation, "all that is needed are two hands". Mouth-to-mouth ventilation was also the subject of intensive research at this time, and within months the two techniques were combined as cardiopulmonary resuscitation (CPR), which rapidly became universally accepted [2]. Recovery after cardiac arrest then became possible both in hospital and in the community, provided that adequate CPR could be provided within a few minutes of circulatory arrest.

Over time, increasing attention was paid to the perceived need for intubation by healthcare professionals and to adjuvant drug treatment. But despite new techniques, increasing experience, widespread training, and ever-greater resources, the percentage of attempts that had a successful outcome may not have improved over recent decades [3,4]. To a degree, this must reflect the changing pattern of cardiac arrest. Ventricular fibrillation causes a decreasing proportion of cardiac arrest; more people now present with asystole or pulseless electrical activity, that offer considerably less opportunity for the restoration of an effective heart beat [5].

Poor performance, too, has been a factor in the disappointing rate of progress. Various observational studies have examined the electronic records taken when automated defibrillators have been used during attempted resuscitations. These studies have revealed that ventilation is associated with lengthy interruptions between compression sequences - in addition to unexplained pauses that might have occurred during drug therapy or other maneuvers [4,6,7]. Thus, far fewer compressions are administered than are recommended. Excessive ventilation rates

of patients intubated by healthcare professionals also reduce the time for compressions and impede venous return [8]. In addition, compression rates tend to deviate widely from the recommended 100 per minute [7,9], and the depth as measured by a novel accelerometer technique is usually inadequate [10]. Thus, blood flow during cardiac arrest is generally markedly less than that necessary to maintain viability of the brain and heart. This was recognized by the International Liaison Committee on Resuscitation; the revised guidelines of 2005 placed renewed emphasis on compressions, and increased the compression-to-ventilation ratio from 15:2 to 30:2 for the treatment of cardiac arrests in both adults and children [11].

In favor of compression-only

Although this change in emphasis has been generally welcomed, some feel that the recommendation for resuscitation by lay bystanders should be simplified by teaching compression-only, without ventilation. The arguments in favor of a return to the 'two hands' technique are based on several factors:

1. Studies have shown that compression-only is easier to teach, that compression numbers are closer to ideal, and that skill retention is improved [12].
2. Many bystanders are reluctant or even unwilling to attempt mouth-to-mouth resuscitation on strangers - either for aesthetic reasons or from fear of infection [13] - and panic or fear of causing harm deters others [14].
3. As with bystanders, single-rescuer paramedics take much longer to switch from compression to ventilation than the notional 4 seconds that have been suggested as appropriate [12,15].
4. Adequate mouth-to-mouth ventilation is very hard to achieve; valuable time is wasted on attempts that are usually fruitless, even for lay persons who have been trained and re-trained in CPR [16].
5. Experimental swine studies have shown that, over a period of CPR as long as 12 minutes, as much oxygen is delivered to the myocardium by compression alone as it is by full CPR, because the gain from increased blood-flow outweighs the disadvantage of decreased oxygen saturation (that occurs only when the lungs and arterial blood have become depleted) [17].
6. Three human observational studies have not shown any negative impact on survival with the use of compressions only [18-20].

Mindful of all these factors, the American Heart Association has endorsed, as an acceptable option, the use of compression-only resuscitation by bystanders for sudden, witnessed, adult, cardiac arrest [21]. Ewy has campaigned to make this the norm; he uses the term cardiocerebral resuscitation, which excludes any implication that attention will be given to ventilation [22]. He and his colleagues have extended the simpler technique even to healthcare professionals; but the improved survival that was observed in two cities after the change [23] has yet to be confirmed in randomized trials.

Against compression-only

The European Resuscitation Council does not, at present, encourage this approach, even for laypersons [24]. Various cogent arguments can be put forward for maintaining traditional CPR:

1. Hypoxia is the primary cause of many cardiac arrests, notably cases of drowning and drug overdose.
2. Cardiac arrest in children is also likely to be hypoxic, from these causes or from respiratory obstruction.
3. Untrained bystanders might not be able to distinguish between types of circulatory arrest, and even if they can do so they might find it difficult to remember that different techniques should be used; but conventional CPR is appropriate for all cases.
4. Single rescuers will tire more quickly when attempting continuous compressions [25].
5. Moreover, the relevance of the animal data on the potential for adequate myocardial oxygen delivery over a period of 12 minutes or so is unproven, and indeed there is also contrary evidence [26].

6. The revised 2005 guidelines, with the increased emphasis on compression, are held to be a reasonable compromise; further change - when many are only now adapting to the recent modification - would cause appreciable confusion. Above all, abandoning the wisdom of nearly 50 years without the evidence of controlled trials may be unwise.

Conclusions

The debate continues on what role, if any, should be accorded to compression-only resuscitation. Ideally, major changes in recommendations *should* be tested by randomized trials; however, for bystander resuscitation in the prehospital environment, where compression-only has most relevance, randomized trials are probably impossible to conduct.

Major decisions rest on the balance of the educational advantage of a single technique set against the different circumstances of cardiac arrest that ideally require a different emphasis in immediate treatment. Although the now-universal 30:2 compression to ventilation ratio for community resuscitation is not appropriate to children with hypoxic cardiac arrest, a hospital patient who develops primary ventricular fibrillation, and who can be defibrillated within a few minutes, should not require ventilation. The 'one size fits all' philosophy does have educational advantages but it may or may not achieve the greatest overall benefit.

Opinion, however, is moving towards compression-only resuscitation for bystanders who receive at most only modest training. The argument that they will be more likely to respond, and will achieve more that is useful, seems compelling. First-aid workers with regular training should be expected to add artificial ventilation to their skills to deal with prolonged or hypoxic arrests; this is also true of healthcare professionals who work in emergency settings.

For the most experienced, guidelines should never be regarded as being inflexible; the circumstances of an arrest should dictate the degree of priority accorded to ventilation. Chest compression, by contrast, is needed for all cardiac arrests; *'two hands'* remain the mainstay.

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