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USE OF AN ORDINARY PLASTIC WATER BOTTLE AS A VENTILATION AID IN CARDIOPULMONARY RESUSCITATION

ABSTRACT

Background: Cardiopulmonary resuscitation (CPR) requires both chest compressions and assisted ventilation. However, reluctance to perform mouth-to-mouth ventilation due to infection risk and social discomfort reduces its implementation.

Objective: To develop and describe a simple, low-cost, and universally available method for assisted ventilation using a plastic water bottle during CPR.

Method: A disposable plastic water bottle is modified by creating a small aperture at its base. The bottle can be used as a barrier-assisted ventilation device in simulated emergency conditions.

Results: The modified bottle enabled effective air delivery with visible chest rise. It also served as a barrier, minimizing direct contact and improving acceptability.

Conclusion: The plastic bottle method offers a practical alternative for assisted ventilation during CPR in resource-limited or unexpected emergency settings. Further validation studies are required.

Keywords: Cardiopulmonary Resuscitation, COVID-19, World Health Organization.

INTRODUCTION

Cardiopulmonary resuscitation (CPR) is a critical life-saving intervention used in cardiac arrest to maintain circulation and oxygenation. Conventional CPR includes both chest compressions and rescue breathing. However, several studies have reported that bystanders are often reluctant to perform mouth-to-mouth ventilation due to fear of infection transmission, lack of training, and cultural barriers.

This reluctance increased significantly during the COVID-19 pandemic, leading to widespread adoption of compression-only CPR. Although compression-only CPR is beneficial in the early phase, studies indicate that oxygenation decreases progressively after 4-10 minutes, making assisted ventilation essential during prolonged resuscitation. Barrier devices such as face shields and pocket masks improve compliance but are rarely available during emergencies. Therefore, there is a need for a simple, accessible alternative that can be used immediately. This article proposes the use of an ordinary plastic water bottle as an improvised ventilation aid during CPR.

MATERIALS AND METHODS

Device Preparation

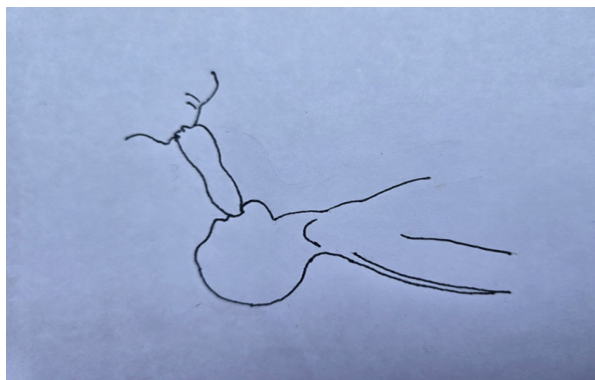
A standard disposable plastic water bottle (approximately 500-600 ml capacity and about 9 inches in length) was used. A small hole (≤ 0.5 inch diameter) was created at the base using a sharp or pointed object such as scissors, knife, pen, or key.

Procedure

1. Position the patient supine with head tilt-chin lift to ensure airway patency.
2. Insert the mouth of the bottle into the patient's mouth, ensuring a tight seal.
3. The rescuer:
 - o Holds the bottle firmly in position
 - o Pinches the patient's nose
4. The rescuer blows air through the aperture into the bottle.

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5. Release the nose to allow passive exhalation.
6. Repeat ventilation cycles along with chest compressions as per CPR guidelines.



RESULTS

The improvised device allowed effective air insufflation with adequate pressure to produce a visible chest rise. The bottle functioned as a barrier, reducing direct mouth-to-mouth contact and potentially increasing rescuer willingness to perform ventilation. The limited volume and elasticity of the bottle appeared to prevent excessive air pressure, reducing the risk of overinflation.

DISCUSSION

CPR was developed as an emergency life-saving procedure which can be done anywhere, by anyone, anytime. Unfortunately, an important pulmonary part of the method has come to be mostly avoided due to the unhygienic contact to the victim, with the potential risk to the rescuer. Various ingenious devices have been designed to overcome this problem, but almost certainly will not be available in an emergency. An emergency procedure should be one that can be done with a device available at hand, for e.g. any sharp object for tracheostomy to save a choking person. The humble, throw-away, 'un-biodegradable', environment-polluting plastic bottle now has one more use, this time a very noble one.

The present innovation of using an ordinary plastic water bottle as a ventilation aid during cardiopulmonary resuscitation (CPR) is supported conceptually and practically by several strands of existing CPR and emergency care research. Similar studies consistently demonstrate that the absence of readily available ventilation devices, fear of infection, and psychological barriers significantly reduce the likelihood of bystanders providing rescue breaths, despite strong physiological evidence supporting assisted ventilation during prolonged resuscitation.¹

Multiple observational and survey-based studies have reported that reluctance to perform mouth-to-mouth ventilation remains one of the primary reasons for incomplete CPR by lay rescuers. Locke et al. and Brenner et al. found that more than 50% of trained bystanders hesitated to provide rescue breathing due to fear of disease transmission and lack of protective barriers. Similar findings were reported by Ong et al. in Asian populations, emphasizing that cultural and

hygienic concerns universally limit bystander participation in ventilation. These findings directly support the rationale for developing an easily available, barrier-based ventilation alternative such as the plastic bottle device.²

Research evaluating pocket masks, face shields, and barrier devices demonstrates that even simple physical separation between rescuer and victim significantly increases willingness to provide rescue breaths. Perkins et al. reported that the presence of any barrier device nearly doubled the likelihood of rescue breathing compared with direct mouth-to-mouth ventilation. Although certified devices are effective, studies consistently note that such equipment is rarely available during unexpected emergencies. The proposed bottle-based method parallels these barrier devices in function while overcoming the limitation of availability, a critical factor highlighted across emergency preparedness literature.³

Physiological studies comparing compression-only CPR with conventional CPR further reinforce the potential value of assisted ventilation using improvised means. Compression-only CPR may be adequate during the initial minutes of cardiac arrest, arterial oxygenation and minute ventilation progressively decline after 4-10 minutes. Animal studies showed significantly better oxygenation, reduced hypercapnia, and improved survival when assisted ventilation was added to chest compressions during prolonged resuscitation. These findings align with the proposed device's intended use -- providing ventilation when standard equipment is unavailable and compression-only CPR may become insufficient.⁴

Experimental studies assessing manual ventilation techniques reveal that precise tidal volume delivery is less critical than achieving visible chest rise. Idris, Babbs et al. showed that lay rescuers often deliver variable tidal volumes regardless of the ventilation method used, including bag-valve masks. Importantly, moderate positive pressure ventilation was sufficient to maintain gas exchange without increasing the risk of barotrauma. The limited volume and compliance of a plastic bottle may inherently restrict excessive insufflation, making it a potentially safer alternative to forceful mouth-to-mouth ventilation by untrained rescuers⁵

Similar principles have been applied successfully in other improvised medical devices. Studies on homemade spacers for asthma inhalers have demonstrated comparable drug delivery and clinical effectiveness when standard devices were unavailable. Emergency medicine literature also supports improvised airway adjuncts and low-cost innovations in disaster and low-resource settings, emphasizing that simplicity and accessibility often determine real-world effectiveness. The plastic bottle ventilation method aligns with this evidence-based approach to context-appropriate emergency innovation.⁶

Concerns regarding infection transmission during CPR have been widely studied. Handley et al. and other systematic reviews reported that documented cases of disease transmission during CPR are extremely rare, particularly when a physical barrier is present. The disposable nature

of the plastic bottle further minimizes cross-contamination risk and eliminates reuse concerns, findings consistent with infection-control research favoring single-use barrier devices in emergency care.⁷

International CPR guidelines increasingly acknowledge the need for pragmatic solutions in resource-limited environments. The World Health Organization and the European Resuscitation Council emphasize that first aid and resuscitation strategies should be adaptable to local resources without compromising core physiological principles. The proposed method supports this guideline-based approach by maintaining airway ventilation while addressing real-world barriers identified in prior studies.⁸

Overall, when interpreted alongside existing research on bystander behavior, barrier-assisted ventilation, compression-only CPR limitations, and improvised medical devices, the plastic bottle ventilation technique represents a logical and evidence-consistent innovation⁹. In scenarios where no ventilation device is available and mouth-to-mouth breathing is refused, this method may bridge the critical gap between ideal and actual resuscitation practice. Further experimental and simulation-based studies are recommended to quantify delivered tidal volume, oxygenation efficiency, and rescuer acceptability, as suggested by prior research on alternative ventilation strategies.¹⁰

CONCLUSION

The plastic water bottle ventilation method is a simple, cost-effective, and widely accessible innovation for assisted ventilation during CPR. It has the potential to bridge the gap between ideal CPR practice and real-world limitations. Further studies are needed to evaluate its effectiveness, safety, and acceptability in clinical and simulation settings.

Limitations

- Lack of quantitative measurement of tidal volume and oxygenation
- No clinical or randomized controlled trials
- Variability in bottle size and user technique

Recommendations

- Conduct simulation-based and clinical validation studies
- Compare with standard barrier devices
- Incorporate into first-aid training after validation

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