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Clinical paper

Does lying in the recovery position increase the likelihood of not delivering cardiopulmonary resuscitation?

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ABSTRACT

Background: Resuscitation guidelines endorse unconscious and normally breathing out-of-hospital victims to be placed in the recovery position to secure airway patency, but recently a debate has been opened as to whether the recovery position threatens the cardiac arrest victim's safety assessment and delays the start of cardiopulmonary resuscitation.
Aim: To compare the assessment of the victim's breathing arrest while placed in the recovery position versus maintaining an open airway with the continuous head tilt and chin lift technique to know whether the recovery position delays the cardiac arrest victim's assessment and the start of cardiopulmonary resuscitation.
Methods: Basic life support-trained university students were randomly divided into two groups: one received a standardized cardiopulmonary resuscitation refresher course including the recovery position and the other received a modified cardiopulmonary resuscitation course using continuous head tilt and chin lift for unconscious and spontaneously breathing patients. A human simulation test to evaluate the victim's breathing assessment was performed a week later.
Result: In total, 59 participants with an average age of 21.9 years were included. Only 14 of 27 (51.85%) students in the recovery position group versus 23 of 28 (82.14%) in the head tilt and chin lift group $p = 0.006$ (OR 6.571) detected breathing arrest within 2 min.
Conclusion: The recovery position hindered breathing assessment, delayed breathing arrest identification and the initiation of cardiac compressions, and significantly increased the likelihood of not starting cardiopulmonary resuscitation when compared to the results shown when the continuous head tilt and chin lift technique was used.

Introduction

Out-of-hospital cardiac arrest (OHCA) is one of the most important causes of death in Europe[1–3]. The incidence of cardiopulmonary resuscitation (CPR) attempts ranges from 19.0 to 104.0 per 100,000 people per year[4], with an overall survival of at least 30 days for 10.38%. Early recognition and prompt initiation of bystander CPR are critical for successful defibrillation[5–8] and to improve the victim's outcome and thus doubling or quadrupling a victim's chances of survival[9–12].

Breathing assessment is a fundamental step in recognizing OHCA and was included in the basic life support (BLS) section of current CPR guidelines[13], substituting pulse assessment, with the aim of achieving a higher OHCA detection rate and greater likelihood of bystanders delivering cardiac compressions. However, breathing assessment can be quite challenging[14,15] when it is carried out in the first few minutes of witnessed OHCA: the victim may appear to be breathing normally during the first minute[16] but agonal breathing may appear after that and could last for up to approximately the sixth[16] or the ninth minute[17]. After several minutes, these breathing patterns become slower and more erratic and culminate in breathing arrest. Agonal breathing can be present in up to 59.7% of OHCA[17–19] and is difficult to distinguish from spontaneous breathing; 21% of lay persons could not determine whether the victim was

Abbreviations: CPR, cardiopulmonary resuscitation; OHCA, out-of-hospital cardiac arrest; BLS, basic life support; HTCL, head tilt and chin lift technique; RP, recovery position; EMS, emergency medical services; ERC, European resuscitation guidelines.

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breathing normally[19]. Breathing assessment can be further complicated in the case of comatose victims because of a variety of possible circumstances (drug or alcohol overdose, seizure, syncope, cerebrovascular event, and hypoglycemia), which can resemble agonal movements, and according to studies, up to 45% of the victims evaluated by the dispatcher as OHCA were not in arrest[20]. Therefore, it is necessary to constantly monitor the victim's breathing during these first minutes, and if the witness is not certain that the victim is breathing normally, then CPR must be started.

Current CPR guidelines[13] endorse the head tilt and chin lift (HTCL) technique as the ideal way to initially assess breathing and recovery position (RP)[13,21] as the recommended position to place out-of-hospital unresponsive and normally breathing victims in because of the lack of demonstrated associated risk. However, the evidence available to support this is weak and mainly historical[22–32], from before the development of mobile telephony, when the person who had to alert the emergency medical services (EMS) was forced to abandon the victim to request help. Nowadays, with the spread of mobile phone lines[33,34] around the world (in 2014 the number of mobile phones equaled the world's population), the situation has changed. Until today, no study reporting the improvement of a victim's chances of survival with the use of RP has been published[35,36]. However, a letter[37] highlighting a series of cases in which OHCA victims were initially placed in RP by bystanders and the subsequent loss of breathing was not detected and no CPR was initiated by witnesses opened a debate[38] whether RP threatens the assessment of a cardiac arrest victim in OHCA.

The aim of the study was to compare the victim's breathing assessment and arrest detection when placed in RP versus placed on his back maintaining an open airway with the HTCL technique to find whether RP hinders the cardiac arrest victim's assessment and delays the start of CPR.

Methods

Design, sample, and setting

Sample

Students from the Faculty of Teacher Training at the University of Santiago de Compostela, Lugo, trained in BLS were included in this study. As inclusion criteria, the students had to be trained in CPR according to the European Resuscitation Council (ERC) Guidelines for Resuscitation 2015 (Fig. 1 and Table 1).

Their participation in the study was voluntary and selfless. The research project was approved by the ethical committee of University of Santiago de Compostela, respecting the ethical principles of the Helsinki Convention. Each participant signed informed consent, authorizing the transfer of his data for this study.

Study design

The participants were randomly divided into two groups and were given a refresher BLS training course, including the use of the HTCL maneuver for opening the airway to check breathing according to current CPR Guidelines[13] but with one remarkable difference: the students in the first group were taught to place the unconscious and normally breathing victim in the RP and then to check breathing regularly. The students in the second group received the same training but were taught to maintain an open airway with the HTLC technique in the case of an unconscious and normally breathing victim. The victim's back was on the floor and the student was at the victim's side according to the current CPR guidelines' Picture[13], just as the skill was taught for opening the airway during the first assessment, and the student constantly monitored the victim's breathing. Both the courses highlighted the importance of continuously monitoring the victim's breathing and to start CPR if they were not certain if the victim was breathing normally. They were also informed of the challenge involved in assessing breathing[14], and the most common characteristics that appear in agonal breathing were also explained[15]. Both courses also included an on manikin dispatcher-assisted CPR simulation so that participants would always know that they could request dispatcher assistance at any time.

One week after the BLS refresher course, a study was conducted in two identical isolated rooms at the Faculty of Teacher Training in Lugo (Spain). The participants were told that the purpose of the study was to evaluate cardiac arrest situations in a simulation performed by real actors who played the victims.

The students came into the room where the simulation was done one by one. An actor, an observer, and a third person who was responsible for the actor's safety were inside the room. The actors were expert scuba divers who participated in competitive prolonged apnea diving. They had previously been instructed on how to simulate normal and agonal breathing. The observer assessed the participants and recorded the times. The third person kept the participants from delivering cardiac compressions to scuba diver. The participants' intention of delivering chest compressions was taken as "chest compressions start." A fully equipped advanced life support team of three people (physician, nurse, and paramedic) was on stand-by in another room throughout the simulation.

The simulation went as follows: The actor suffered an episode of severe chest pain followed by a sharp fall to the ground and unconsciousness, witnessed by the participant. The actor was breathing normally at the time of the fall[16], but his breathing patterns became progressively slower and deteriorated over 2 min and concluded in breathing arrest. After breathing arrest, the actor remained in apnea for another 2 min or until the recognition of the situation by the participant.

The participants were provided with a smartphone when they came into the room. The victim's fall to the ground was taken as the start time. The student then phoned the EMS number (061) and performed the different steps of the adult BLS sequence. The simulation ended 4 min after the start time or at the time the participants attempted to deliver chest compressions.

Data analysis

The primary objective of this study was to assess the association between the victim's position, RP and HTCL, and the percentage of participants who recognized abnormal breathing or breathing arrest. The *odds ratio* (OR) (95% confident interval (CI)) and $\chi 2$ was calculated to look for statistically significant differences. The chosen level of significance was 0.05. The Student's *t*-test for independent samples was conducted to see whether there was a significant difference between recognition percentages and mean times.

Results

Fifty-nine student volunteers aged 21–31 ($M = 21.94$; SD = 1.82) were enrolled. Of them, 19 (32.2%) were male and 40 (67.8%) female. All the participants assessed the victim before calling the EMS number. None of them requested dispatcher assistance to guide the assessment.

After the victim's initial assessment, four (8.48%) participants, two from each group, who concluded the victim to be unconscious and breathing abnormally, started cardiac compressions. This implied the end of the simulation. Fifty-five (91.52%) participants evaluated the victim's state as unresponsive but normally breathing; 27 placed the victim in RP and 28 in HTCL. Out of the 27 participants that placed the victim in RP, 14 (51.8%) detected

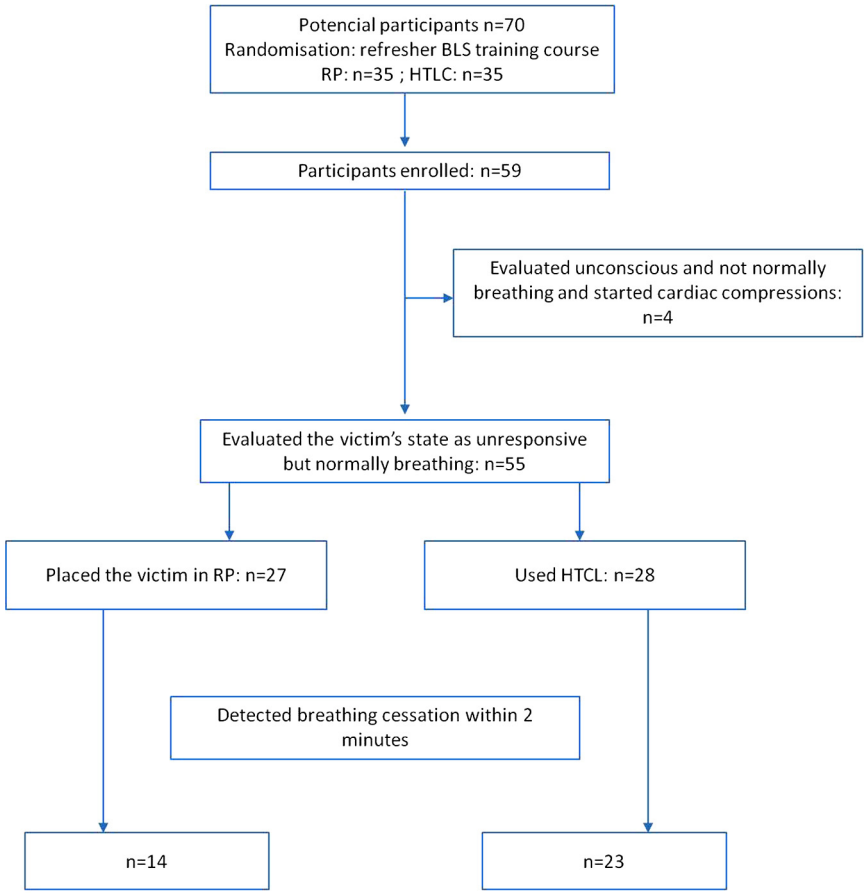

Fig. 1. Flowchart showing the distribution of participants.

Table 1
Descriptive data for the variables analyzed.

Variable		RP $n=27$ (100%)	HTCL $n=28$ (100%)
Identification of breathing cessation (CR)%	No	13 (48.14%)	5 (17.85%)
	Yes	14 (51.85%)	23 (82.14%)
Identification time of breathing cessation within 2 min of apnea (M and R)		31.92 s (2–104)	17.52 s (4–47)

Number of participants (n), Mean (M), Range (R), head tilt and chin lift technique (HTCL), recovery position (RP).

breathing cessation within 2 min of its being produced and started cardiac compressions compared to the 23 (82.14%) out of the 28 in the HTCL group, which is a statistically significant difference ($p = 0.006$). The odds ratio (OR) of 6.571 clearly favors HTLC.

The time required by the participants who detected breathing cessation and initiated cardiac compression within 2 min of it being initiated varies greatly. The RP group took an average of 31.92 s (range = 2–104; SD = 25.49) to detect it as compared to the HTCL group that took an average of 17.52 s (range = 4–47; SD 11.37). The difference in the mean detection time of breathing cessation was statistically significant, $t_{(35)} = 2.365$ ($p = 0.024$).

Discussion

This study of OHCA simulation demonstrates that placing the unconscious and spontaneously breathing victim in RP hinders breathing assessment compared to those placed using the HTCL technique. The use of RP decreases the detection of breathing cessation, and thus, the percentage of the participants delivering cardiac compressions is lower. However, RP significantly increased (OR 6.571) the likelihood of not starting cardiac compressions within the first 4 min, and it took on average 14 s longer to recognize breathing arrest and initiate CPR.

As the strengths of the study, it is worth mentioning that the results were statistically significant and the OR was high; moreover, the study proposed a progressive model of breathing deterioration. The simulation was active and involved the participation of real-life scuba divers who simulated different cardiac arrest breathing patterns[16] (from breathing normally to breathing cessation) over a period of time, from 0 to 4 min. This approach might be more realistic than other models when using a single pattern.

The study proposes not only placing the victim in the HTCL position but also changing the concept of checking breathing regularly to continuously monitoring the victim's breathing, which might affect the victim's final outcome.

However, this was just a simulation study and only simulates one evolutive breathing pattern that probably does not reflect all the possible breathing patterns of an OHCA. The study only reproduced the first 4 min of witnessed OHCA because of the difficulties of the scuba divers repeatedly holding their breath for extended

periods of time. We do not know what the percentage of breathing detection cessation would be after the fourth minute, but the fact that only one participant (2.7%) detected breathing arrest after the third minute leads us to believe that it would probably be quite low.

To our knowledge, there are no studies available involving breathing assessment with the victim placed in RP and comparing HTCL airway patency with RP patency.

Similar to previous breathing assessment studies, this study once again highlights the difficulty of bystanders to accurately assess breathing[14,15,19,20]. The breathing deterioration model proposed in this study began with a nearly normal ten breaths per minute rate when the participants first assessed the victim. In total, 91.52% of the participants evaluated this pattern as breathing normally, which is lower than that seen (97%) in the study involving a fixed human simulation pattern. Then the breathing deteriorated, and from the first to the second minute, the pattern was clearly agonal; however, none of the participants started CPR at this time compared to 44–75% in the fixed human simulation. Then from the second minute onward, breathing arrest was simulated: the detection of breathing cessation reached 82.14% using HTCL and 51% using RP, compared to the 94–97% in another human simulation study. However, the model reproduced the first minute of an OHCA, which despite normal breathing would have required chest compressions. Our results were poor despite the fact that the importance of starting CPR when they are not certain whether the victim was breathing normally was reinforced in both groups only one week before[15]. The use of an active model reproducing three sequential breathing patterns might have complicated the assessment compared to using just one pattern. Furthermore, none of the participants used the dispatcher-assisted CPR. We do not know what would have happened if our participants had used dispatcher-assisted CPR, but some current studies state that dispatchers guiding lay bystanders can recognize up to around 43% of OHCA[39] and improve bystander CPR from 61.8% to up to 66.8% of OHCA patients[40]. In this study, 55% of the participants in the RP group and 83% in the HTLC group would have started CPR.

ERC guidelines recommend the HTCL technique to open the airway to assess breathing, and this study showed that keeping the unconscious and spontaneously breathing victim in HTCL under continuous visual observation clearly improved the likelihood of detecting breathing cessation and subsequently the application of chest compressions. Because of its relative simplicity and because it is already integrated into CPR courses, the decision to use HTCL on unresponsive and normally breathing victims could at least be as easily learned and retained as RP, which would simplify the protocol and shorten the duration of CPR courses. Chin lift, a simple variation, can also be safely used on unconscious and spontaneously breathing traumatic victims when RP may not be advisable[21]. The use of RP may have been useful prior to the development of the mobile phone, and there may still be occasions when it might be used such as in the case of an elevated number of victims or if it is necessary to leave the victim alone. However, this study was only a simulation and more research providing solid evidence must be conducted.

The main limitation of this study is that it is a human simulation. Despite the fact that the study was carried out with two expert scuba divers who were trained to imitate breathing deterioration, there may be some differences seen with real victims. The study reproduced only the first 4 min of witnessed OHCA due to the simulating capacity of the scuba divers. During the refresher course, special emphasis was given to continuously reassess breathing so as not to favor either technique. We did so because no time recommendations are given in the current CPR guidelines[13] (check breathing regularly). In the refresher CPR course, no video tape of agonal breathing was shown, and only a description of its main characteristics was given.

Conclusions

The first minutes of a simulated witnessed OHCA breathing assessment are challenging.

The RP hindered the breathing assessment, delayed breathing arrest identification and the initiation of cardiac compressions, and significantly increased the likelihood of not starting CPR compared to the results shown when the continuous HTCL technique was applied.

Conflicts of interest

None of the authors have any financial and personal relationship with other people or organizations that could inappropriately influence their work.

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Editorial

Should we still be teaching the recovery position?

The concept of turning an unconscious, breathing victim onto the side to maintain an open airway was introduced in the late-19th century, but only became standard teaching in the mid-20th century [1]. Ever since the first 'advisory statements' of the International Liaison Committee on Resuscitation (ILCOR) in 1997 [2], the recovery position has been a feature of international adult basic life support (BLS) guidelines [3]. But what is the evidence that it is superior to the supine position in terms of the ability to maintain a clear airway?

Every five years, from 2000 to 2015, ILCOR has published an 'international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations' (CoSTR). These have summarised the science supporting various aspects of resuscitation, assigning a level of evidence to each of the final recommendations. The recovery position has been the subject of the ILC0R process on two occasions, once in 2005 [4] and once in 2015 [5]. In 2005, no evidence was found to recommend one particular version rather than another, but the question of whether the recovery position should be used at all was not addressed. In 2015, there was a fuller review, the conclusion being a 'weak recommendation' in favour of the recovery position, on the basis of 'very-low-quality evidence'.

There has been a recent multi-centre, prospective, observational study of children presenting to an emergency department following an episode of unconsciousness [6]. The authors produced good evidence to suggest that those children who had been turned into the recovery position whilst unconscious had a significantly lower incidence of needing subsequent hospital admission than those who had not. There was no comparison with alternative positions, and the circumstances and aetiology of loss of consciousness in children differs from those of adults.

Thus, in 2017, after 20 years and five publications of CoSTR, we are still being recommended to use the recovery position with only weak evidence preferring this to an alternative, supine position with airway support.

In 2016, a letter to the journal Resuscitation reported a series of 7, out-of-hospital, adult survivors from cardiac arrest who had been evaluated by lay rescuers as unresponsive but breathing normally, and therefore placed into the recovery position. When the emergency medical services (EMS) arrived, they found that each was in respiratory arrest, undetected by the rescuers. It was concluded that the rescuers had failed to notice that breathing had stopped because the victims were in the recovery position, and the authors recommended that this should no longer be taught. Instead, unconscious, breathing victims should be placed on their back, with their airways maintained open by a head-tilt-chin-lift manoeuvre [7].

Stimulated by these findings, the same authors have now undertaken a study comparing the ability of rescuers to assess a victim's breathing whilst in the recovery position, rather than supine with an open airway maintained by the head-tilt-chin-lift technique. This is reported in the current issue of Resuscitation [8].

Fifty-nine university students, trained in BLS, were divided into two groups. During refresher training, one group was taught to place an unconscious victim with normal breathing into the recovery position, and the other group was taught to maintain the victim supine, using head-tilt-chin-lift to keep the airway open. Both groups were taught to monitor breathing after placement of the victim. A week later they were tested using live 'victims' who were trained SCUBA divers able to breath-hold for prolonged periods. In the scenario, the divers simulated unconsciousness with normal breathing for 2 min, then agonal breathing for 2 min, then apnoea for a further 2 min.

During the 2 min when the victims simulated agonal breathing, only 4 rescuers (2 from each group) recognised the need to start chest compressions. During the 2 min of apnoea, only 14 out of 27 (51.85%) rescuers in the recovery-position group detected the cessation of breathing, compared with 23 out of 28 (82.14%) in the supine-position group, a significant difference ($p = 0.006$; OR 6.571). The authors conclude that use of the recovery position hinders assessment of breathing, delays the recognition of apnoea and increases the likelihood that CPR would not be started when needed. They suggest that standard teaching should be to maintain unconscious, breathing victims supine, keeping the airway open with head-tilt-chin-lift, only using the recovery position if the rescuer needs to leave, for example to alert the EMS.

The authors admit the limitations of a simulation study, but the use of breath-holding experts to act as victims is novel and goes some way towards mitigating this weakness. It has to be noted that only 4 out of 59 rescuers were able to detect agonal breathing before the onset of apnoea. The divers' training consisted only of a verbal description of agonal breathing, without a demonstration video, so It could be that the simulations were poor. Nevertheless, there remains an impressive difference in the rate of detection of apnoea between those victims placed in the recovery position and those lain supine.

So, on the strength of this study, should we change adult BLS teaching?

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First, these findings need to be confirmed. Then, there are a number of unanswered questions that need exploring.

Although the head-tilt-chin-lift technique is taught as part of the initial assessment of an unconscious, non-breathing victim [3], there is little published evidence as to how well this is performed in practice; nor whether this can be maintained for prolonged periods by lay persons. It used to be thought that checking for an absent pulse was reasonably easy during BLS, but this was found to be a myth [9]. How well can the airway be opened by rescuers in reality?

It may be well be that observation of the victim is clearer when he or she is supine, but a clear airway may be easier to obtain in the lateral position. This needs to be investigated.

What if the out-of-hospital rescuer is alone and without an immediate means of telephoning the emergency services? What if there are multiple casualties or any other need to leave an unconscious, breathing victim alone? Should the recovery position be an additional technique to be taught?

Lastly, it must not be forgotten that there is a difference between teaching lay persons and healthcare professionals, for whom airway manoeuvres are often already within their skill sets.

The original letter and this study are good examples of the need to keep an open mind on potential fallacies in long-held dogmas, and then subject them to more rigorous investigation. The authors are to be congratulated on bringing this potential problem to the fore.

Should we now stop teaching the recovery position as part of adult BLS? Not without some answers to the questions above. Meanwhile, though, it is even more important to stress the need for a close check on all unconscious victims to ensure that their breathing remains normal until the EMS arrives [10].

Conflict of interest

AJH is Vice-Chair of the ERC BLS/AED Working Group and author/co-author of some of the cited references.

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