Following On-site Instructions for Operating Laryngeal Mask Supreme™ and Laryngeal Tube™ as an Alternative to Mouth-to-Mouth Ventilation in Layperson CPR: A Randomized Trial in the Manikin

Gereon Schälte*, Christian Stoppe, Rolf Roissaint, Malie Heuser, Laura Gilles, Marlon Schwarz, Mark Coburn, Norbert Zoremba and Annette Rieg

Department of Anesthesiology, University Hospital Aachen, Aachen, Germany

Abstract

Background: “Chest compressions only” resuscitation (CCOR) has been suggested one method of increasing laypersons attendance providing bystander resuscitation, avoiding mouth-to-mouth (MTM) ventilation and improving patients’ outcome. In prolonged CCOR without rescue breaths and a non-cardiac origin, neurological outcome is very much dependent on oxygenation. As an alternative to MTM we investigated laypersons ability to operate supraglottic airway devices (SAD) in the manikin, following illustrated on-site instruction.

Methods: Laypersons were handed a bag containing either an LMAS or an LT, a bag-mask-valve device (BMV), a syringe prefilled with air, and an instruction manual consisting of four annotated diagrams displaying the correct use of either the Laryngeal Mask Supreme™ (LMAS) or the Laryngeal Tube™ (LT). They were then asked to perform and ventilate a manikin as displayed. The process was evaluated in quantity and quality.

Results: A total of 299 laypersons were enrolled, 145 applicants in the LMAS (96.7%) and 143 in the LT (96%) group inserted the SAD in the right direction. Previous BLS education was not associated with a higher rate of success (LMAS (P=0.85) vs. LT (P=0.63)). The most common error identified was the depth of insertion (LT 40.9% (n=61) vs. LMAS 32.7% (n=49); P=0.18). No significant difference was found with regard to positioning the devices twisted or reversed (LT 4.7% (n=7) vs. LMAS 6% (n=9); P=0.79).

Conclusion: In simulated setting laypersons can achieve appropriate skills and understanding for both SADs using a simple instruction manual. Application of SADs may be improved by a better labeling, the quality of the instruction sheet and a reduction in steps required.

Keywords: Layperson mask; Layperson tube; Mouth-to-Mouth ventilation

Introduction

Immediate initiation of bystander pulmonary resuscitation (CPR) improves survival and outcome [1,2]. Cardio-cerebral resuscitation (CCR=CCOR) might be equivalent or superior to CPR in patients with out of hospital cardiac arrest (OHCA) in both survival rate and neurologic benefits. However, in non-cardiac origin cardiac arrest, survival rate was better with CPR [3]. For prolonged OHCA (>15 min) of cardiac origin, conventional CPR with rescue breathing provided incremental benefit compared with either no CPR or CCOR [3,4]. Despite basic life support (BLS) education laypersons are often hesitant to provide this adequately in case of emergency [5]. Reasons given are various and include fear of potential infection and distaste for blood and bodily fluids. In addition, a low self-confidence with skills learned, plus the fear of doing harm and the associated legal aspects are frequently expressed. Moreover, mouth-to-mouth ventilation (MTM) is associated with an increased incidence of regurgitation during CPR. The willingness to provide MTM is influenced by the victim’s age, attributes and how well they are known to the rescuer [6]. In unknown adults it is lower than 50%, even among professional healthcare providers, whereas the willingness to provide chest compressions (CCOR) alone is >90% [7,8]. Laypersons experienced in CPR have a greater tendency to perform bystander CPR than people without [9,10].

In 2008 the American Heart Association (AHA) simplified the CPR guidelines and focused on providing adequate and early chest compressions and defibrillation [11,12]. The AHA and International Liaison Committee on Resuscitation (ILCOR) point out that the steps taken by rescuers—whether layperson or healthcare professional—are determined by their level of training and by local circumstances, and specifically state that a trained (lay) CPR provider should provide breaths in a 30:2 ratio [13,14]. Bag-valve-mask ventilation (BMV) has been shown to be difficult in layperson’s hands, whereas the insertion of SAD during CPR is associated not only with higher quality ventilation, but also higher quality chest compressions and a lower incidence of aspiration and associated pulmonary complications [15-18]. Two recent published studies stated that laypersons can operate LMAS in the manikin, after either on-site instruction using a four-diagram manual, or after completing a one-hour theoretical lecture including a practical demonstration [19,20]. We hypothesize that these findings may be extended to include the Laryngeal Mask Supreme™ (LMAS) and the Laryngeal Tube™ (LT) devices in emergency resuscitation by laypersons. If so, this would further support the case for supplying SADs along with other standard BLS equipment (such as AED’s in public) as a means of reducing individuals’ threshold to initiate early and effective therapy. In the present study we compare aspects of individual performance and technical problems between the two devices, and discuss potential limitations and improvements to their use.

---

*Corresponding author: Dr. Gereon Schälte, Department of Anesthesiology, University Hospital Aachen Pauwelsstr. 3052074, Aachen, Germany, Tel: +49241800; E-mail: gschaelte@ukaachen.de

Received December 03, 2012; Accepted December 14, 2012; Published December 20, 2012

Citation: Schälte G, Stoppe C, Roissaint R, Heuser M, Gilles L, et al. (2012) Following On-site Instructions for Operating Laryngeal Mask Supreme™ and Laryngeal Tube™ as an Alternative to Mouth-to-Mouth Ventilation in Layperson CPR: A Randomized Trial in the Manikin. J Anesth Clin Res 3(12): 265. doi:10.4172/2155-6148.1000265

Copyright: © 2012 Schälte G, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
We conducted a randomized simulation study enrolling untrained laypersons and comparing two SAD (LMAS, seize #4, LMA Deutschland GmbH, Bonn, Germany & LT, seize #4, VBM Medizintechnik GmbH, Sulz a.N., Germany) after on-site instruction by four annotated diagrams. The institutional review board waived the requirement for written informed consent. No personal data except age, academic background and first aid training were collected, and no influence on any participant’s health was expected. All subjects agreed to being evaluated anonymously for scientific and educational purposes. Prerequisites for inclusion were the lack of any previous medical education (i.e. physician, nurse, EMT, paramedic) other than a BLS course, and an age of 18 or older. Applicants were recruited at the Rheinisch-Westfälische-Technische-Hochschule (RWTH) Aachen University campus (Audimax & Kármán Auditorium). Experimental data were recorded “on-site”. A resuscitation scenario with an Ambu® M MegaCode W manikin was prepared in an enclosed area. Participants were isolated from any inadvertent exposure to the scenario and to other participants’ post-trial. We designed for each device an instruction manual illustrating with four annotated photographs (plus “close-ups”), step-by-step instructions for use, with important technical aspects (e.g. connection of the syringe to the cuff-inflation port) highlighted (Figure 1).

Two separate boxed sets of airway management tools “LMAS” and “LT” were prepared for use. For easier and more intuitive use the connectors between the airway devices and the BMV were both color-coded red. Further labels on each device indicated the approximate correct depth of insertion. The cuff inflation syringes were pre-filled with the appropriate volume of air (20 ml for LMAS or 35 ml for LT). An additional label on the syringe indicated the correct volume of air required. Squeezing the BMV was displayed using two hands. Both devices were established to fit to the manikin’s anatomy and to provide an adequate seal once the cuff had been correctly inflated. The instruction manuals were supplied packaged with the individual devices. Participants were approached and asked to take part in a scientific trial investigating a new alternative to “mouth-to-mouth” ventilation in a dummy. In order to avoid potential learning bias participants performed a single trial with one device only. They were randomized to one of the SADs and were given standardized instructions before entering the experimental area: “Behind the wall you will find an unconscious person that has stopped breathing. On the scene a first-responder has already started with chest compression. You are responsible for their ventilation. To do this you should use the boxed devices next to the head. Do not perform “mouth-to-mouth” ventilation. Open the bag and proceed as displayed on the instruction sheet”.

Participants then entered the experimental scene and proceeded. A study-team member initiated continuous chest compression in the meantime and continued during the individual trial. Each time starting ventilation (BMV squeeze) chest compression was interrupted for adequate quantification. Time was recorded starting when the bag was opened and stopped either after ventilation was correctly initiated or the trial was ended by the applicant or—after 2 min—by the investigators. The manikin’s surfaces and the SADs were lubricated. During the entire trial both devices were re-used. In each group one device drop-out was observed, both related to a cuff-leak after more than 50 trials. The correct insertion of the LMAS or LT, cuff inflation, connection and compression of the BMV and individual corrective efforts (if any) were judged. Multiple compressions of the BMV were allowed as displayed.
in the manual. In addition, we recorded the number of insertions completed within 2 minutes. Ventilation with a tidal volume of >500 ml was judged as "sufficient" in accordance with ILCOR guidelines. Tidal volumes of between 150 ml and 500 ml were judged as "ILCOR insufficient" and ventilation with tidal volumes <150 ml (equivalent to estimated dead space) were judged as "insufficient". After the trial applicants were interviewed and asked their opinion of the materials, instructions, and their understanding of BMV ventilation. Finally, they were asked whether they would feel competent to operate an SAD in a real-life resuscitation scenario by following the instruction manual. Primary endpoint was the insertion of the devices in the right direction. Secondary endpoint was a quantitative combined endpoint of insertion, tidal volume > 150ml and ventilation achieved within 120s.

Statistics

Statistical analysis was performed using SAS (Statistical Analyses System), (SAS Institute GmbH, Heidelberg, Germany). A success rate of 95% was expected [19,21]. The power was calculated with a significance level, α=0.05. A power of 80% requires a sample size of 120 in each group. In total 150 (LMAS) and 149 (LT) applicants were included to compensate for possible dropouts. The power calculation was performed using nQuery Advisor® Version 7.0 (Statistical Solutions, Saugus, MA, USA). A Chi-squared test was used to calculate statistical differences in success rates with respect to gender, previous BLS training, and studying in the field of engineering. A T-test was used to calculate statistical differences in time of insertion with respect to age and sex. Correlation was calculated by regression analysis. Data are presented as means ± standard deviations unless stated otherwise. A P <0.05 indicated statistical significance.

Results

Data from a total of 299 laypersons (LT n=149 and LMAS n=150) were analyzed. Mean age was 22.3 (22.3 ± 3.5) years in the LT group and 22.9 (22.9 ± 2.8) years in the LMAS group (n.s.). 76.3% of the participants were male (n=228) and 23.7% female (n=71) (Table 1). Overall 96.7% (n=145) of the applicants in the LMAS and 96% (n=143) in the LT group inserted the SAD in the correct orientation. No significant difference between devices was found with regard to incorrect insertion, e.g. rotated or inverted (LT 4.7%, n=7 vs. LMAS 6%, n=9; P=0.79). Applicants identified and corrected 6 out of 7 faulty insertions in the LT and 5 out of 9 in the LMAS group (P=0.3).

Quantitative procedural analysis (insertion, tidal volume >150 ml and ventilation in <120 s) revealed a total of 94 (63%) applicants in the LT and 119 (79.3%) in the LMAS group successfully initiating ventilation (P=0.0022). Time needed for insertion and successful first ventilation was 80.6 ± 26.2s (LT) and 75.1 ± 23.9s (LMAS) respectively (P=0.017) (Figure 1). A quantitative comparison of the two devices using the more strict criteria of an error-free performance and a tidal volume >150ml could be detected. Time needed for insertion and a successful #rst ventilation was 80.6 ± 26.2s (LT) and 75.1 ± 23.9s (LMAS) respectively (P=0.017). Data are numbers.

![Figure 2: Time to successful insertion and ventilation (tidal volume >150 ml).](image)

Analysis of procedural mistakes regarding LT and LMAS insertion: No significant difference could be observed regarding withdrawal of the materials, inserting devices up to the correct depth, correction of a tilt head and the right direction of the device. Data are numbers and percentage.

| Step of induction                                      | LT  | LMAS | P value |
|--------------------------------------------------------|-----|------|---------|
| 1. Withdrawal of material from bag                     | 0 (0%) | 0 (0%) |        |
| 2. Head tilt                                           | 28 (18.8%) | 30 (20%) | 0.79   |
| no correction                                          | 21 (75%) | 27 (90%) | 0.18   |
| 3. Wrong direction of device                           | 7 (4.7%) | 9 (6%)   | 0.79   |
| no correction                                          | 6 (85.7%) | 5 (55.6%) | 0.14   |
| 4. No insertion up to marker                           | 61 (40.9%) | 49 (32.7%) | 0.15   |
| no correction                                          | 58 (85.1%) | 42 (85.7%) | 0.06   |
| 5. Cuff inflation                                      | 22 (14.8%) | 9 (6%)   | 0.001  |
| 6. No connection to BVM                                | 11 (7.4%) | 1 (0.7%)  | 0.003  |
| 7. Forgotten squeeze of BVM                            | 3 (2%)   | 1 (0.7%)  | 0.3    |
| 8. Cuff valve identification                           | 12 (8%)  | 33 (22%)  | 0.03   |

Analysis of procedural mistakes identified using LT or LMAS:

![Figure 2: Procedural mistakes identified using LT or LMAS.](image)

Success rates for both devices were independent from previous BLS education (LMAS: P=0.85 and LT: P=0.63). Data are presented as percentage. No significant difference between the devices regarding time to ventilation applying a tidal volume >150ml could be detected. Time needed for insertion and a successful #rst ventilation was 80.6 ± 26.2s (LT) and 75.1 ± 23.9s (LMAS) respectively (P=0.17).

![Figure 3: Classification of participants regarding school and faculty.](image)
In accordance to recent publications, confirming that verbal guidance
within two minutes, indicating basic understanding and uptake of the
LMAS and in the LT group inserted the SAD in the correct orientation
and subsequently all unsuccessful applicants succeeded.

After the individual trial all participants were given verbal feedback
stated they would prefer further training, and only 4% (n=12) (LT 4%
of the applicants (LT 42.3%, n=63
vs.

Identifying the correct depth of insertion was the most common
problem found in this trial, despite the use of indicator labels. This
might be one explanation for the differences in quantity revealed
between the two secondary endpoints “ILCOR conformity” and
“combined”. Interestingly, no other study investigating laypersons’
or novices’ performance with SAD has described this previously.
There may be several reasons: the atmosphere we attempted to create
was low-pressure and more explorative, with the possible result that
participants tended to avoid applying too much force when inserting
the SAD and had no way of gauging how much manual force might
be required for correct placement. Surprisingly, only a few applicants
noticed and corrected an incorrect depth of insertion, despite this
being clearly displayed on the instruction sheet and indicated by a red
label on the SAD.

Cuff inflation

Once the cuff was inflated, on noting that the tidal volume applied
was insufficient or a leak was present, most laypersons tried to improve
the positioning of the device. In this case all applicants first attempted
to do so with the cuff still inflated. In this configuration, repositioning
the LMAS was easier to achieve than in the LT. The technique of
deflating the cuff before repositioning was not used indicating a clear
gap in the understanding of the use of cuffed devices. Therefore, if
the process of inflating the cuff itself caused mal-positioning or a leak, this
proved difficult to correct.

Identifying the cuff inflation valve as the appropriate place to
connect the syringe was reported as more difficult in the LMAS
(P=0.03). The LT body is transparent white while its cuff and inflation
line are colored, making them easier to identify than in the LMAS. In
addition, following correct identification of the valve, connecting the
syringe and inflating the correct volume of air proved to be another
pitfall. Interestingly, these problems (i.e. a leak between syringe and
valve, an incorrect volume of air, and failing to remove the syringe
from the valve) were found more frequently in the LT group (P=0.001).
In the case of users not familiar with connecting a syringe to a small
valve this process is always a weak link. Inflations made without a tight
connection frequently led to an incomplete inflation of the balloon and
resulted in major leakage. Alternatively, where a tight seal was achieved
and the syringe left connected to the valve, air might flow back into the
syringe, also resulting in an inadequate seal. Finally, whatever the cause
to acquire all relevant information and skills during the trial itself.
According the secondary endpoint time to ventilation in the present
study appears rather long (80.6 ± 26.2s (LT) and 75.1 ± 23.9 s (LMAS)).
In contrast to our scenario individual trials were performed after
previous instructions by, brief demonstration, video, telephone,
written instructions or classic teaching [21-24]. In first year medical
students without any prior manual training and instruction time to
insert SADs were found at 55s (Laryngeal Mask) and 38s (Laryngeal
Mask Fastrach) and could significantly be reduced after minimal
instruction [25]. Onsite reading and understanding instructions
takes its time. This is likely to account for the comparatively longer
times to ventilation found here. In case of a single bystander initiated
CCOR, an interruption of cardio-compression for inserting an SAD
in approximately 1.5 min, will discredit efforts in CCOR campaigns
focusing “cerebral resuscitation”. For gasping occurs frequently early
after OHCR of cardiac origin, initiating immediate CCOR in a “more
than one” bystander scenario, and a secured airway within 1.5 minutes,
neurologic outcome may favorably be influenced. Regular CPR was of
an incremental benefit in OHCR of non-cardiac origin [26].

Identifying the correct depth of insertion was the most common
problem found in this trial, despite the use of indicator labels. This
might be one explanation for the differences in quantity revealed
between the two secondary endpoints “ILCOR conformity” and
“combined”. Interestingly, no other study investigating laypersons’
or novices’ performance with SAD has described this previously.
There may be several reasons: the atmosphere we attempted to create
was low-pressure and more explorative, with the possible result that
participants tended to avoid applying too much force when inserting
the SAD and had no way of gauging how much manual force might
be required for correct placement. Surprisingly, only a few applicants
noticed and corrected an incorrect depth of insertion, despite this
being clearly displayed on the instruction sheet and indicated by a red
label on the SAD.

Cuff inflation

Once the cuff was inflated, on noting that the tidal volume applied
was insufficient or a leak was present, most laypersons tried to improve
the positioning of the device. In this case all applicants first attempted
to do so with the cuff still inflated. In this configuration, repositioning
the LMAS was easier to achieve than in the LT. The technique of
deflating the cuff before repositioning was not used indicating a clear
gap in the understanding of the use of cuffed devices. Therefore, if
the process of inflating the cuff itself caused mal-positioning or a leak, this
proved difficult to correct.

Identifying the cuff inflation valve as the appropriate place to
connect the syringe was reported as more difficult in the LMAS
(P=0.03). The LT body is transparent white while its cuff and inflation
line are colored, making them easier to identify than in the LMAS. In
addition, following correct identification of the valve, connecting the
syringe and inflating the correct volume of air proved to be another
pitfall. Interestingly, these problems (i.e. a leak between syringe and
valve, an incorrect volume of air, and failing to remove the syringe
from the valve) were found more frequently in the LT group (P=0.001).
In the case of users not familiar with connecting a syringe to a small
valve this process is always a weak link. Inflations made without a tight
connection frequently led to an incomplete inflation of the balloon and
resulted in major leakage. Alternatively, where a tight seal was achieved
and the syringe left connected to the valve, air might flow back into the
syringe, also resulting in an inadequate seal. Finally, whatever the cause

>500 ml did not reveal a significant difference between both SAD (LT
46.6%, n=76 vs. LMAS 53.4%, n=87; p=0.23).

Significantly, more persons in LT group failed to connect the BMV
to the device within a 120s interval (LT 7.4% (n=11) vs. LMAS 0.7%
(n=1); P=0.003). 3 participants in the LT and one participant in the
LMAS group forgot to squeeze the BMV (P=0.3) (Table 2). In both
groups participants were most commonly mechanical engineering
students followed by civil engineering. For both devices the attribute
“engineering” however, did not come along with a higher rate of success
(LMAS P=0.07 vs. LT P=0.9) (Figure 3). 21 of the applicants (7%) had
no previous BLS training (LT 6.1%, n=9; vs. LMAS 8%, n=12; P=0.65).
In both groups previous BLS education was not associated with a higher
rate of success (LMAS: P=0.85 and LT: P=0.63) (Figure 4). The most
common error identified in both groups was the depth of insertion (LT
40.9%, n=61 vs. LMAS 32.7%, n=49; P=0.18) followed by an incorrect
or omitted head-tilt on the dummy (LT 18.8%, n=21 vs. LMAS 20%,
n=27; P=0.53). As stated by the applicants in both groups however,
understanding and operating the devices themselves was subjectively
the most serious problem (LT 22.8% (n=34) vs. LMAS 24% (n=36;
P=0.89) and was not dependent one a specific SAD. Furthermore,
the content of the instruction manual and the quality of the diagrams was
judged “improvable” for both (LT 16.8%, n=25 vs. LMA 23.3%, n=35;
P=0.15). Significantly more people in the LMAS group reported the
cuff inflation valve hard to identify (LMAS 22%, n=33 vs. LT 8%, n=12;
P=0.03). Inflating the cuff was reported as significantly more difficult
in the LT group (LT 14.8%, n=22 vs. LMAS 6%, n=9; P=0.001). After
their trial 175 laypersons (58%) (LT 54%, n=80 vs. LMA 63.3%, n=95;
P=0.77) stated they would feel confident to operate an SAD in a “real
emergency situation without further training. A further 37.5% (n=112)
of the applicants (LT 42.3%, n=63 vs. LMAS 32.7%, n=49; P=0.76)
states they would prefer further training, and only 4% (n=12) (LT 4%
vs. LMA 4%) confirmed they would decline to use the devices at all.
After the individual trial all participants were given verbal feedback
and subsequently all unsuccessful applicants succeeded.

Discussion

Discounting technical or procedural errors most applicants in the
LMAS and in the LT group inserted the SAD in the correct orientation
within two minutes, indicating basic understanding and uptake of the
central skill involved. Following ILCOR criteria (tidal volume above
500 ml), no significant difference between the two devices was found.
In accordance to recent publications, confirming that verbal guidance
is likely to further improve performance, all applicants succeed after
final explanations [21,22].

Operating SAD

Participants were not pre-trained or pre-instructed, and had

Citations: Schähte G, Stoppe C, Rossaint R, Heuser M, Gilles L, et al. (2012) Following On-site Instructions for Operating Laryngeal Mask Supreme™
and Laryngeal Tube™ as an Alternative to Mouth-to-Mouth Ventilation in Layperson CPR: A Randomized Trial in the Manikin. J Anesth Clin
Res 3:265. doi:10.4172/2155-6148.1000265

Figure 4: Device specific success rates (Vt>150 ml) related to previous BLS education.
of insufficient inflation, laypersons must understand the need to refill the syringe with air before reconnecting it to the device and further inflation.

**BMV connection**

Difficulties connecting the BMV to the device were described significantly more often in the LT group (LMAS 9 vs. LT 22; P=0.014). In LMAS the presence of the channel for a gastric decompression led to errors in connection, despite having a different diameter to the BMV connector and the absence of the red color code. In both groups a total of 4 participants simply forgot to squeeze the BMV within the two minutes despite this being displayed in the instruction manual (P=0.3). In the hands of laypersons and in the more stressful context of a real resuscitation scenario, the use of a device without the need for cuff inflation (i.e. the I-gel laryngeal mask) may simplify the procedure and improve performance. [21,27-29].

**BLS training and education**

Individual success rates operating the LMAS or the LT were shown to be independent of previous BLS training. Similar findings have recently been published concerning the ability of laypersons to operate SADs after instructions by telephone or brief demonstration only [22,24]. We did not find that engineering students (with their assumed higher level of technical aptitude) outperformed students from other faculties with either device [19,24].

**SADs**

SADs are easier to insert than a tracheal tube and, unlike endotracheal intubation, can generally be placed without interrupting chest compressions [20,30,31]. They are in widespread use, following their incorporation in difficult airway algorithms worldwide as per the ILCOR guidelines [32]. Following brief instructions laypersons have been shown to operate the LMA Fastrach® faster than the LT in the manikin [24]. In both the experienced and the novice, the LMAS has been found to be superior to both the ProSeal® and the LMA Classic® in terms of speed and ease of insertion, effectiveness of ventilation and quality of seal [33-35]. The LT has an excellent alternative to tracheal intubation during daily anesthesia practice in managing the difficult airway, whether expected or unexpected. Both devices have been proven valuable in the out-of-hospital airway management, and have shown to reduce “no-flow time” during professional CPR, even in the hands of the inexperienced [18,19,35,36]. In patients, success rates for novices placing SADs were found to be over 80% and were found even higher (>90%) in the manikin [20,26,37].

**Rescue breathing**

Whether the practice of teaching rescue breathing to laypersons should be stopped in favor of CCOR, also known as cardio-cerebral resuscitation (CCR) is a debate still ongoing. A part of the case for doing so is that it will increase the chances of a bystander providing CPR—and any CPR is better than none [38-40]. There is increasing evidence that in witnessed collapse associated with cardiac arrest (the most common cause in adults) and fast paramedic response times (<10 min), CCOR is associated with better or at least equivalent survival rates [38-40]. Of note, all studies were completed before the introduction of the current 30:2 CPR guidelines. During unconsciousness, the human airway is rather flaccid and will tend to occlude without active maneuvers to keep it patent (e.g. chin lift, ETI, SAD etc.) [41,42]. Performing CPR without ventilation leads to a steady decrease in blood oxygenation and, after approximately 6 minutes, the advantages of continuous CCOR are offset by hypoxemia. Even a single rescue breath delivered every 100 compressions, has been shown to favorably influence outcome [43]. Gasping or abnormal breathing is common after cardiac arrest but decreases within minutes. Patients gasping at initialization of CPR are associated with a favorable outcome [44].

**Limitations**

Some limitations should be discussed. The RWTH Aachen University was founded as a technical university, and is still dominated by a majority of male students. Correspondingly we make no attempt to analyze gender related differences. Results presented are obtained in a manikin model and cannot be directly transferred into (pre) clinical practice. Operating and inserting an SAD in the manikin may differ significantly from inserting the same device in patients [27,45]. Moreover, different manikins do not perform equally, and no one manikin performs best for SAD insertion. Therefore, care is required when studying and comparing the performances of different SADs [27]. Nevertheless, there is currently no substitute for the safe, standardized and robust environment provided by the manikin, and which is essential for a feasibility study such as ours. The correct insertion of an SAD and achievement of a good seal is more difficult in patients than in manikins, with lower success rates and more time required [29,45]. Correspondingly, we simply cite our secondary combined endpoint “time to insertion and successful ventilation” and refrain from further discussion in favor of presenting our procedural findings. In this context we use “correct direction of insertion” of the devices as an indicator of a rudimentary understanding and uptake of how an SAD is used.

Choosing university students, though non-medical still confers a bias with respect to educational level compared to the general population. However, it remains speculative as to whether this variable would influence performance. In a recent trial we showed that after a brief demonstration a non-academic population is enabled to operate SAD in the manikin with a high rate of success [24].

With respect to ILCOR and ASA guidelines emphasizing the clear benefit in survival after early defibrillation, airway management and installation of an AED might “compete” and conflict in sequence and, of course, might overburden lay responders without basic AED or SAD training. It remains speculative if laypersons would prefer either AED or SAD when both are available onsite and, instructions are provided by an illustrated diagram only.

It is clear that the establishment of SAD-assisted ventilation is faster when subjects receive instruction in advance, regardless of the training modality [21-24]. The implementation of SADs and their “troubleshooting” in BLS courses is likely to lead to higher rates of success in their use, as well as wider acceptance of the importance of achieving ventilation in the course of delayed initiation or prolonged CPR and OHCA of non-cardiac origin [14,26,46]. However, instructions given by an illustrated operation manual may be considered an adjunct to any SAD, enabling laypersons to operate SAD in case of emergency, either without previous skills training or as a tool recapitulation and summing up lessons learned in future BLS classes.

**Conclusion**

In a matter of minutes and a high degree of success, using four
illustrated diagrams, and without any prior training, laypersons can acquire the basic understanding and skills to operate two different SADs in the manikin. We envisage that CCOR would be initiated, then within a certain period of time a second person would establish ventilation using an SAD, with instructions supplied on-site, and without interruption to chest compressions. This approach may also bring about an improvement in laypersons compliance with the demand for bystander resuscitation and reduce individuals’ threshold providing MTM ventilation.

References

1. Kitamura T, Iwami T, Kawamura T, Nitta M, Nagao K, et al. (2012) Nationwide Improvements in Survival From Out-of-Hospital Cardiac Arrest in Japan. Circulation. 126: 2834-2843.

2. Adielsson A, Hollenberg J, Karlsson T, Lindqvist J, Lundin S, et al. (2011) Increase in survival and bystander CPR in out-of-hospital shockable arrhythmia: bystander CPR and female gender are predictors of improved outcome. Experiences from Sweden in an 18-year perspective. Heart 97: 1391-1396.

3. Yang CL, Wen J, Li YP, Shi YK (2012) Cardiocerebral resuscitation vs cardiopulmonary resuscitation for cardiac arrest: a systematic review. Am J Emerg Med 30: 784-793.

4. Kitamura T, Iwami T, Kawamura T, Nagao K, Tanaka H, et al. (2011) Time-dependent effectiveness of chest compression-only and conventional cardiopulmonary resuscitation for out-of-hospital cardiac arrest of cardiac origin. Resuscitation 82: 3-9.

5. Cho GC, Sohn YD, Kang KH, Lee WW, Lin KS, et al. (2010) The effect of basic life support education on laypersons’ willingness in performing bystander hands only cardiopulmonary resuscitation. Resuscitation 81:691-694.

6. Taniguchi T, Sato K, Fujita T, Okajima M, Takamura M (2012) Attitudes to Bystander Cardiopulmonary Resuscitation in Japan in 2010. Circ J 2012 76: 1130-1135.

7. Horowitz BZ, Matheny L (1997) Health care professionals’ willingness to do mouth-to-mouth resuscitation. West J Med 167: 392-397.

8. Giammario M, Fritelli W, Belli R, Chingaliga A, De Micheli B, et al. (2005) Does reluctance to perform mouth-to-mouth ventilation exist among emergency healthcare providers as first responders? Ital Heart J Suppl 6: 90-104.

9. Tanigawa K, Iwami T, Nishiyama C, Nonogi H, Kawamura T (2011) Are trained individuals more likely to perform bystander CPR? An observational study. Resuscitation 82: 523-528.

10. Vrckunen I, Kujala S, Rynänen S, Vuori A, Pettilä V, et al. (2006) Bystander mouth-to-mouth ventilation and regurgitation during cardiopulmonary resuscitation. J Intem Emerg Med 30: 39-42.

11. Sayre MR, Berg RA, Cave DM Page RL, Potts J, et al. (2008) Hands-only (compression-only) cardiopulmonary resuscitation: a call to action for bystander response to adults who experience out-of-hospital sudden cardiac arrest: a science advisory for the public from the American Heart Association Emergency Cardiovascular Care Committee. Circulation 117: 2162-2167.

12. Herlitz J, Engdahl J, Svensson L, Angquist KA, Young M, et al. (2005) Factors associated with an increased chance of survival among patients suffering from an out-of-hospital cardiac arrest in a national perspective in Sweden. Am Heart J 149: 61-66.

13. Berg RA, Hemphill R, Abella BS (2010) Part 5: adult basic life support: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science. Circulation 122: S685-S705.

14. Anantharaman V (2011) Chest compression-only CPR or good quality 30:2 CPR. Singapore Med J 52: 576-581.

15. Länkimäki S, Alahuta S, Kurola J (2012) Feasibility of a laryngeal tube for airway management during cardiac arrest by first responders. Resuscitation.

16. Rueztler K, Roessler B, Potura L, Priemayr A, Robak O, et al. (2011) Performance and skill retention of intubation by paramedics using seven different airway devices – A manikin study. Resuscitation 82: 593-597.

17. Heuer JF, Barwing J, Elch C, Quintel M, Crozier TA, et al. (2010) Initial ventilation through laryngeal tube instead of face mask in out-of-hospital cardiopulmonary arrest is effective and safe. Eur J Emerg Med 17: 10-15.

18. Bowman FP, Menegazzi JJ, Check BD, Duckett TM (1995) Lower esophageal sphincter pressure during prolonged cardiac arrest and resuscitation. Ann Emerg Med 26: 216-219.

19. Schälte G, Stoppe C, Rossaint R, Gilles L, Heuser M, et al. (2012) Does a 4 diagram manual enable laypersons to operate the laryngeal mask supraglottic(R)? A pilot study in the manikin. Scand J Trauma Resusc Emerg Med 20: 21.

20. Goliash G, Ruetzler A, Fischer H, Frass M, Sessler DI, et al. (2012) Evaluation of advanced airway management in absolutely inexperienced hands: a randomized manikin trial. Eur J Emerg Med.

21. Kurola J, Paakkonen H, Kettunen T, Laakso JP, Gorski J, et al. (2011) Feasibility of written instructions in airway management training of laryngotube. Scand J Trauma Resusc Emerg Med 19: 56.

22. Beauchamp G, Pramapus P, Guyette FX (2009) Simulated rescue airway use by laypersons with scripted telephonic instruction. Resuscitation 80: 525-529.

23. Jokela J, Nurmi J, Grenzwoerker HV, Castren M (2009) Laryngeal tube and intubating laryngeal mask insertion in a manikin by first-responder trainees after a short video-clip demonstration. Prehospital Disater Med 24: 63-66.

24. Schälte G, Stoppe C, Aktas M, Coburn M, Rex S et al. (2011) Laypersons can successfully place supraglottic airways with 3 minutes of training. A comparison of four different devices in the manikin. Scand J Trauma Resusc Emerg Med 24: 60.

25. Bickenbach J, Schälte G, Beckers S, Fries M, Derwall M et al. (2009) The intuitive use of laryngeal airway tools by first year medical students. BMC Emerg Med 9: 18.

26. Kitamura T, Iwami T, Kawamura T, Nagao K, Tanaka H, et al. (2010) Bystander-initiated rescue breathing for out-of-hospital cardiac arrests of noncardiac origin. Circulation 122: 293-299.

27. Jackson KM, Cook TM (2007) Evaluation of four airway training manikins as patient simulators for the insertion of eight types of supraglottic airway devices. Anaesthesia 62: 388-393.

28. Gabbott DA, Beringer R (2007) The IGEL supraglottic airway: a potential role for resuscitation? Resuscitation 73: 161-162.

29. Howes BW, Wharton NM, Gibbison B, Cook TM (2010) LMA Supreme insertion by novices in manikins and patients. Anaesthesia 65: 343-347.

30. Gatward JJ, Thomas MJ, Nolan JP, Cook TM (2008) Effect of chest compressions on the time taken to insert airway devices in a manikin. Br J Anaesth 100: 351-356.

31. Kurola J, Pere P, Niemi-Murola L, Siilvast T, Kairaluoma Pet al. (2006) Comparison of airway management with the intubating laryngeal mask, laryngeal tube and CobraPLA by paramedical students in anaesthetized patients. Acta Anaesthesiol Scand 50: 40-44.

32. http://guidelines.erc.org/2010-guidelines-for-cpr/html

33. See E, Rajeev S, Firoz T, Yousaf W, Wong J, et al. (2010) Safety and efficacy of laryngeal mask airway Supreme versus laryngeal mask airway ProSeal: a randomized controlled trial. Eur J Anaesthesiol 7: 602-607.

34. Ali A, Canturk S, Turkmen A, Turgut N, Altan A (2009) Comparison of the laryngeal mask airway Supreme and laryngeal mask airway Classic in adults. J Eura Anaesthesiol 12: 1010-1014.

35. Timmermann A, Cremer S, Heuer J, Braun U, Graf BM, et al. (2008) Laryngeal mask LMA Supreme. Application by medical personnel inexperienced in airway management. Anaesthethist 57: 970-975.

36. Schalik R, Byhahn C, Fausel F, Egner A, Oberndörfer D, et al. (2010) Out-of-hospital airway management by paramedics and emergency physicians using laryngeal tubes. Resuscitation 81: 323-326.

37. Waalewijn RA, Tijssen JG, Koster RW (2001) Bystander initiated actions in out-of-hospital cardiopulmonary resuscitation: results from the Amsterdam Resuscitation Study (ARRESUST). Resuscitation 50: 273-279.

38. Iwami T, Kawamura T, Hiraide A (2007) Effectiveness of bystander cardio-resuscitation in patients with out-of-hospital cardiac arrest. Circulation 118: 2900-2907.

39. Bohm K, Rosenqvist M, Herlitz J (2007) Survival is similar after standard...
treatment and chest compression only in out-of-hospital bystander cardio-
pulmonary resuscitation. Circulation 116: 2908-2912.

40. Kohama H, Komasawa N, Ueki R, Samma A, Nakagawa M et al. (2011) 
Comparison of Supreme® and Soft Seal® laryngeal masks for airway 
management during cardiopulmonary resuscitation in novice doctors: a manikin 
study. J Anesth 25: 98-103.

41. Berg RA, Kern KB, Hilwig RW, Ewy GA (1997) Assisted ventilation durind 
“bystander” CPR in a swine acute myocardial infarction model does not improve 
outcome. Circulation 96: 4364-4371.

42. Idris AH, Becker LB, Fuerst RS, Wenzel V, Rush WJ, et al. (1994) Effect of 
ventilation on resuscitation in an animal model of cardiac arrest. Circulation 
90: 3063-3069.

43. Idris AH, Banner MJ, Wenzel V, Fuerst RS, Becker LB, et al. (1994) Ventilation 
caused by external chest compression is unable to sustain effective gas 
exchange during CPR: a comparison with mechanical ventilation. Resuscitation 
28: 143-150.

44. Bobrow BJ, Zuercher M, Ewy GA, Clark L, Chikani V, et al. (2008) Gasping 
during cardiac arrest in humans is frequent and associated with improved 
survival. Circulation 118: 2550-2554.

45. Rai MR, Popat MT (2011) Evaluation of airway equipment: man or manikin? 
Anaesthesia 66: 1-3.

46. O’Keefe C, Nicholl J, Turner J, Goodacre S (2011) Role of ambulance response 
times in survival of patients with out-of-hospital cardiac arrest. Emerg Med J 28: 
703-706.