Airway pressure with chest compressions versus Heimlich manoeuvre in recently dead adults with complete airway obstruction

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Abstract

In a previous case report a standard chest compression successfully removed a foreign body from the airway after the Heimlich manoeuvre had failed. Based on this case, standard chest compressions and Heimlich manoeuvres were performed by emergency physicians on 12 unselected cadavers with a simulated complete airway obstruction in a randomised crossover design. The mean peak airway pressure was significantly lower with abdominal thrusts compared to chest compressions, 26.4 ± 19.8 cmH2O versus 40.8 ± 16.4 cmH2O, respectively (P = 0.005, 95% confidence interval for the mean difference 5.3–23.4 cmH2O). Standard chest compressions therefore have the potential of being more effective than the Heimlich manoeuvre for the management of complete airway obstruction by a foreign body in an unconscious patient. Removal of the Heimlich manoeuvre from the resuscitation algorithm for unconscious patients with suspected airway obstruction will also simplify training. © 2000 Elsevier Science Ireland Ltd. All rights reserved.

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1. Introduction

Foreign body airway obstruction is an uncommon but preventable cause of cardiac arrest, with an incidence of 0.65–0.9/100,000 [1,2] as a cause of death. In choking victims who stop breathing the European Resuscitation Council (ERC) recommends up to five sharp slaps between the shoulder blades, followed by abdominal thrusts (the Heimlich manoeuvre) if this fails. If the victim becomes unconscious, this is to be followed by ‘the sequence of life support’ [3]. The American Heart Association (AHA) recommends the Heimlich manoeuvre with alternating finger sweeps as the only technique [4], arguing that back blows may not be as effective as Heimlich manoeuvre in adults [5,6]. The AHA also claims that this will simplify training [4].

Based on a single case report Skulberg [7] suggested that standard chest compressions could be a better technique. If this is true, two additional goals might be achieved. It would simplify what needs to be learned for CPR and reduce the time without circulation from chest compressions in patients with cardiac arrest. We have therefore conducted a study of the airway pressure generated by chest compressions compared to abdominal thrusts in recently dead patients. Human cadavers were selected instead of animals, as the shape of the chest is different between animals and humans which makes extrapolation of data from one to the other unreliable.

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2. Materials and methods

The study was approved by the Regional Committee for Medical Research Ethics and performed in the Emergency Medical Service System of Oslo. Cadavers are not covered by the Helsinki declaration, and the ethics committee did not require informed consent from relatives. Twelve unselected recently dead adults of either sex were studied immediately after unsuccessful resuscitation from prehospital cardiac arrest. While still intubated and with the cuff inflated to create an airtight seal, the tracheal tube (ID 8.0 mm) was connected to a handheld pneumotachograph (VentCheck™, model 101, Novametrix Medical Systems, CT, USA) for airway pressure measurements. The proximal end of the sensor was plugged to stimulate complete airway obstruction.

The peak pressures achieved with five standard chest compressions were compared with peak pressures achieved with five abdominal thrusts (Heimlich manoeuvre) in a randomised, crossover design. Before starting each procedure it was ensured that the lungs were in the resting expiratory position. Four male emergency physicians weighing 80–90 kg performed the procedures. All were advanced life support instructors with many years of practical CPR experience. Both procedures were performed according to the European Resuscitation Council guidelines [3]. The abdominal thrusts were given kneeling astride the supine cadaver. Two paramedics controlled the performance of the procedures and recorded the results. The physicians received no feedback and were blinded from the results. Patient sex, age, particulars about their size/shape and complications during CPR such as rib fractures or lung aspiration were recorded.

The mean pressures generated by the five chest compressions were compared to the mean pressures generated by the five abdominal thrusts using Jandel SigmaStat© statistical software (Erkrath, Germany). Each cadaver served as its own control. After assessing the distribution of the data distribution, a paired t-test was used. Data are presented as means ± SD.

3. Results

Ten recently dead men and two women with a mean age of 68 ± 15 years and mean body weight of 80 ± 15 kg were studied. Rib fractures were noted in three patients and pulmonary aspiration in one during the preceding resuscitation. One patient was very thin and the physician noted that he felt very little resistance in the epigastric region during abdominal thrusts before he felt the vertebral column. One corpse was extremely obese with a potbelly.

The mean peak airway pressure was significantly lower during abdominal thrusts compared to chest compressions, 26.4 ± 19.8 cmH₂O versus 40.8 ± 16.4 cmH₂O (P = 0.005, 95% confidence interval for the mean difference 5.3–23.4 cmH₂O) (Fig. 1). In all but one cadaver, the extremely obese subject, the mean airway pressure was higher with chest compressions compared to abdominal thrusts. In two cadavers, the very thin subject, and an 80 kg woman with pulmonary aspiration, there was no detectable airway pressure change at all with abdominal thrusts (patients 1 and 2, Fig. 1)

4. Discussion

In this study we achieved higher airway pressures with standard CPR chest compressions than with abdominal thrusts in recently dead subjects with complete airway obstruction.
Since the introduction of abdominal thrusts by Heimlich in 1974 [6] there has been debate and controversy regarding which manual rescue technique is most efficient in choking victims. Most studies have compared abdominal thrusts, various chest thrusts and back blows [5,8–10]. For unconscious patients the suggested technique has been the Heimlich manoeuvre with rescuer sitting astride the patient. In the unconscious, markedly obese victim the AHA advocates chest thrusts (the hand position being identical to that for chest compressions) as an option. This is in contrast to our findings, where the noticeably corpulent subject was the only one where abdominal thrusts generated a higher airway pressure. In 1992 Skulberg [7] suggested that chest compressions might be more effective than the Heimlich manoeuvre in the unconscious subject. This was based on a case where the Heimlich manoeuvre failed to dislodge a foreign body in an unconscious patient. As the patient also was pulseless, CPR was then started, and the airway was cleared with the first chest compression. The present study confirms Skulberg’s hypothesis. We are aware of only one study of standard CPR chest compressions for foreign body removal. Gordon et al. [8] compared chest compressions with the Heimlich manoeuvre in six adult, anaesthetised volunteers and found pressures in the same range for the two methods (23 versus 17 cmH₂O, respectively). Their findings have, to our knowledge, never been published in a peer-reviewed journal and there is no specific description of the way they performed the chest compression other than ‘standard external compression’. It is not known if chest compressions were done according to the current recommended guidelines. It would not be ethical to do 4–5 cm compression of the sternum in healthy volunteers because of the significant risk of causing damage such as rib fractures, and the pressures achieved by Gordon et al. were lower with both techniques than in the present study.

In 1978, Ruben et al. [10] compared the Heimlich manoeuvre with sternal thrusts on six cadavers and found higher pressure with the latter, median 18 (range 0–62) versus 30 (range 16–40) cmH₂O, respectively.

It has been speculated that the removal of a foreign body is dependent both on the pressure required to dislodge it and the ability to maintain pressure and potential air flow over time [8,11]. Thus, while a precordial thump might give a high peak pressure, it is sustained for only a very brief period with low flow rates [8]. The pressure is applied for a longer time with chest compressions. In the study by Gordon et al. [8] the airflows both with a partial airway obstruction and an open airway were similar for the Heimlich manoeuvre and chest compressions.

Substituting chest compressions for the Heimlich manoeuvre in unconscious patients has potential advantages in addition to creating a higher airway pressure. It will remove one step in managing an unconscious patient with cardiac arrest. The patient will be treated identically whether or not there is a foreign body airway obstruction. This should reduce confusion and improve training and practical performance. There is much evidence in the literature that the learning and retention of CPR skills is not very efficient [12–14]. There are many psychomotor skills to achieve, and there has been a drive towards simplifying CPR in the hope that this will reduce rescuer confusion and improve performance [15]. If removal of a foreign body can be achieved by chest compressions, this will also reduce the time without circulation in the patient with cardiac arrest.

In conclusion, the present findings indicate that standard chest compressions are more effective than the Heimlich manoeuvre for treating complete airway obstruction by a foreign body.

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References


