Cricoid Pressure Training: How Useful are Descriptions of Force?

M. E. A. ESCOTT*, H. OWEN†, A. D. STRAHAN‡, J. L. PLUMMER§

Flinders University Clinical Skills and Simulation Unit, Department of Anaesthesia, Flinders Medical Centre, Adelaide, South Australia

SUMMARY

Cricoid pressure has been used for over 200 years. During that time, training in the technique has not changed greatly, despite the well-documented potential for complications if performed improperly. Typically, training relies on quantitative or qualitative descriptions such as “firm” pressure, a number of Newtons of force or equivalent force to that causing pain while pressing on the nose. This study tests the value of these descriptive methods in training to apply cricoid pressure. Fifty subjects were asked to apply cricoid pressure after receiving a description of the force required and again after having tested how much pressure on the bridge of their nose was required to cause discomfort. Initial force, force at 45 seconds, minimum force, and maximum force was recorded. The results were analysed using the Wilcoxon signed ranks test, which showed no significant difference in performance between the two types of training. One subject maintained pressure in the range of 25 to 35 Newtons for the entire 45 seconds of the first attempt but no subject performed this well on the second attempts. The use of qualitative and quantitative descriptors of the appropriate pressure does not appear useful in the training of the technique of cricoid pressure. Training incorporating force feedback is recommended.

Key Words: CRICOID PRESSURE: airway, aspiration, Sellick, regurgitation

Pressing backward on the cricoid cartilage to prevent gastric distension during artificial ventilation was first described in 1776¹. It was reported then that the technique should be applied carefully, because it could cause airway obstruction. More recently, the technique was revised by Sellick who described the finger position and added prevention of acid aspiration during induction of anaesthesia as an indication for use². Sellick described the correct amount of force needed to occlude the oesophagus as “firm” pressure³.

Since then, there has been wide discussion about the actual force or pressure needed to protect the patient from acid aspiration and gastric distension, without compromising the airway. A comprehensive review by Vanner and Asai concluded that forces greater than 40 Newtons (N) could lead to airway obstruction and/or adversely affect visualization of the larynx during intubation⁴. They also concluded that 20 N of force would generally be adequate to prevent regurgitation of gastric contents into the pharynx. Vanner and Asai recommended 30 N of force for “cricoid pressure”, because this would prevent regurgitation at oesophageal pressures up to 40 mmHg, which is far more than expected in most patients. Since then, 30 N of force has been adopted as the ideal force for the application of cricoid pressure. It provides a 20 N interval (20 N to 40 N) for effective and safe application.

Current guidelines on cricoid pressure, and many who use the technique, rely on qualitative descriptors such as “firm” or “moderate” pressure or a number of kilograms. The Australian Resuscitation Council (ARC) policy on cricoid pressure also likens the pressure needed to that of the “pressure against the bridge of one’s nose that causes discomfort or the pressure against one’s cricoid that prevents swallowing”. In contrast, the recent revision of resuscitation policies by the International Liaison Committee on Resuscitation discuss the importance of cricoid pressure during emergency endotracheal intubation and describe the appropriate force as simply “pressure”, but caution against “overzealous pressure”⁶.

*B.A., Medical Student.
‡B.Pharm., Medical Student.
§B.Ph.D., A.Stat., Chief Medical Scientist.

Address for reprints: Prof. H. Owen, Flinders University Clinical Skills and Simulation Unit, Department of Anaesthesia, Flinders Medical Centre, Bedford Park, S.A. 5042.

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This study was undertaken to specifically test the validity of these widely used qualitative and quantitative terms for training in the application of cricoid pressure.

MATERIALS AND METHODS

This study was approved by the Flinders Clinical Research Ethics Committee. Students enrolled in the Flinders University Graduate Entry Medical Program were invited to participate in the study. Consenting subjects were first provided with an explanation of the technique of cricoid pressure, the indications for its use, the necessity for continuous effective pressure, and the possible complications if it is done improperly.

Attempt 1

Subjects were provided with baseline quantitative and qualitative instructions based on Sellick’s description:

“To perform cricoid pressure effectively, you must know what force to apply. Originally this was described as ‘firm’ pressure. The actual force is 30 Newtons, which is approximately 3 kg of force.”

Following the baseline statement, the subjects were shown the location of the cricoid cartilage and the correct finger position for cricoid pressure on an airway demonstration model (part number 25 25 00, Laerdal). Subjects were then tested on a purpose-built cricoid pressure trainer developed by the School of Medicine and School of Informatics and Engineering at Flinders University. The trainer is an anatomically realistic model of head and neck fitted with force sensors that detect the location (cricoid cartilage, thyroid cartilage or trachea), direction (directly backwards or deviation to left or right) and amount of applied force (from 10-50 N). In each evaluation, the subjects were asked to locate the cricoid cartilage and to place their fingers as they would for the procedure. Correct finger positioning and direction of force was confirmed and the subjects were then asked to apply cricoid pressure for 45 seconds. The initial force, force after 45 seconds, the minimum and the maximum forces applied were recorded. Finally, a note was made on whether the force applied was always between 25 and 35 N. We chose a window of 10 N (25 to 35 N) to allow a margin of error of plus or minus 5N during clinical performance.

Attempt 2

After the baseline test, subjects were provided with an additional qualitative instruction regarding the appropriate force needed. The subjects were given this statement to read:

“The Australian Resuscitation Council describes, “... the pressure required to ensure oesophageal closure has been compared with the pressure against the bridge of one’s nose that causes discomfort ...”.”

The subjects were asked to practise this manoeuvre on themselves until they felt comfortable with the amount of pressure needed for this. They then performed cricoid pressure on the model again and the measurements described above were repeated.

There is another statement in the ARC guidelines that likens the correct pressure to the “pressure against one’s cricoid cartilage that prevents swallowing”. This was deliberately avoided in our study, because this amount of pressure has been reported to cause retching in conscious or awake persons.

Forces applied in attempts 1 and 2, that is before and after the “bridge of nose” analogy, were compared using the Wilcoxon signed ranks test. Required sample size was calculated from results obtained in our previous study. It was determined that 30 subjects would provide 90% power to detect a change of 6 N in applied force, using a type I error of 0.05.

RESULTS

The subjects (n=50) were in years 1 to 4 of the Graduate Entry Medical Program and most (90%) had no prior training or experience in applying cricoid pressure. Demographic data are outlined in Table 1.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number (percentage)</th>
</tr>
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<tbody>
<tr>
<td>Male</td>
<td>33 (66%)</td>
</tr>
<tr>
<td>Female</td>
<td>17 (34%)</td>
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</tbody>
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<table>
<thead>
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<th>Year Level</th>
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<tbody>
<tr>
<td>First</td>
<td>7 (14%)</td>
</tr>
<tr>
<td>Second</td>
<td>9 (18%)</td>
</tr>
<tr>
<td>Third</td>
<td>32 (64%)</td>
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<tr>
<td>Fourth</td>
<td>2 (4%)</td>
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</table>

<table>
<thead>
<tr>
<th>Prior Experience</th>
<th>Number (percentage)</th>
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</thead>
<tbody>
<tr>
<td>Yes</td>
<td>5 (10%)</td>
</tr>
<tr>
<td>No</td>
<td>45 (90%)</td>
</tr>
</tbody>
</table>

There were no significant differences between attempt 1 and attempt 2 in relation to the minimum force (P=0.695) or the maximum force (P=0.412) with at least 75% of subjects performing outside the recommended range (Figure 1).

There was also no significant difference between
FIGURE 1: Box plot showing distributions of minimum applied force and maximum applied force at attempts 1 and 2. The bold horizontal lines within the boxes indicate the median force. The lower and upper edges of the box indicate the 25th and 75th percentiles, respectively, and the whiskers extend to the smallest and largest observations. For maximum force, the largest observations coincide with the 75th percentile at 50 N, the greatest force measured by the cricoid pressure trainer. The broken horizontal lines show the target force window of 25 to 35 N.

attempts for initial force ($P=0.489$) or the force at 45 seconds ($P=0.595$). Over 50% of subjects performed cricoid pressure outside the recommended pressure range during both attempts (Figure 2).

Only one subject (1/50) performed within the ideal 25 to 35 N range throughout the first test (attempt 1) and no subject achieved this following the addition of the qualitative description utilising the “bridge of nose” analogy (attempt 2).

DISCUSSION

We have found that the usual and recommended instructions on applying cricoid pressure do not result in appropriate force being applied. Since most staff are trained using these descriptors, it is not surprising that several studies of cricoid pressure have shown that most staff do not apply it effectively.

The ARC recommends that all personnel who might be involved in emergency airway management be proficient in the application of cricoid pressure and the International Liaison Committee on Resuscitation recommends its routine use. These guidelines have arisen because effective cricoid pressure can prevent gastric distension during mask ventilation and prevent regurgitated stomach contents being aspirated during emergency intubation or induction of anaesthesia. Aspiration of gastric and oesophageal contents is a serious complication of anaesthesia, of which the unfasted patient or patient with gastrointestinal reflux is most at risk.

In reporting a number of deaths associated with acid aspiration during anaesthesia, Whittington et al made the observation that Sellick did not specify the pressure to be applied to the cricoid. In subsequent correspondence, Mehrrotra and Paust wrote “... the amount of pressure on the cricoid should be sufficient to cause pain if applied to the bridge of your nose”.

This was the first description of this training technique we could find, but neither a source nor supporting data were offered.

It appears that neither describing the force to apply nor using the bridge of the nose as a trainer are as useful as previously thought. These “training” techniques frequently resulted in inadequate force being applied or so much force that ventilation and/or intubation would likely be made more difficult. This has wider implications, because simply telling someone what to do is not teaching them how to do it. Other studies have shown that health care professionals can learn how to apply the correct force and to maintain that proficiency, at least over a short time.

Many of these studies of training have involved “home made” systems such as pressurized syringes, infant scales, and rolls of adhesive tape. While these methods are adequate to teach application of the appropriate force of cricoid pressure in isolation, they do not require the cricoid cartilage to be located or the technique to be applied in context (while attempting intubation and/or artificial ventilation). It has been suggested that the validity of assessment of cricoid pressure depends on the authenticity of the model.

A device to ensure the correct force is applied consistently has been invented. Called a “cricoid yoke”, the device is basically a force transducer applied to the neck. Unfortunately, it has been reported to cause problems because it may not be applied accurately to the cricoid and may cause tracheal compression or extreme lateral displacement of the larynx, resulting in difficulty with tracheal intubation.

Anaesthetists are liable for complications arising...
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from intubation, including aspiration”. In 1999 Vanner and Asai suggested that “The time has come to make cricoid pressure a safer technique”. Whilst anaesthetists and anaesthetic assistants are shown how to perform cricoid pressure during training, we are not aware of any reports of regular testing or quality assurance. There are too few studies of how well, and for how long, staff retain the ability to apply the required force to recommend a particular training scheme. Clearly, a training device that gives immediate feedback on the applied force and where it is being applied should be a component of a cricoid pressure training program.

In conclusion, we believe that all anaesthesia departments should ensure that all hospital staff who may be required to apply cricoid pressure, do so effectively. Training guidelines on how to judge the force required for safe and effective cricoid pressure, including those of the Australian Resuscitation Council and the International Liaison Committee on Resuscitation, should be revisited.

REFERENCES