**Clinical question.**
In adults and children requiring ventilation (prehospital and in-hospital) does the application and maintenance of cricoid pressure (I) compared to no cricoid pressure (C) reduce the incidence of aspiration (O)?

**Is this question addressing an intervention/therapy, prognosis or diagnosis? Intervention**

**State if this is a proposed new topic or revision of existing worksheet:** new topic

**Conflict of interest specific to this question**
Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No conflicts

**Search strategy (including electronic databases searched).**
- **Medline:** "cricoid pressure" OR "sellick maneuver" 308 hits, Aug 15 2009
- **EMBASE:** (cricoid OR sellick) 1580 hits then delete NOT ("cricoid pressure" OR "sellick maneuver" OR "cricoid force" OR "cricoid cartilage pressure") 275 hits Aug 15 2009
- **Central register of controlled trials:** 0 hits, August 15, 2009
- **Cochrane database for systematic reviews:** 0 hits, August 15, 2009
- **Unique references:** 348
- **Hand search of references:** 6

**State inclusion and exclusion criteria**
The following studies were excluded: review, editorial or commentary (51), not relevant (225)

**Number of articles/sources meeting criteria for further review:**
78 articles met criteria for further review.

### Summary of evidence

#### Evidence Supporting Clinical Question

**Studies conducted under anaesthesia or awake volunteers or cadavers or manikins**

|------|----------------------|------------------------|-----------------------------|

**Level of evidence**

- E1 = Aspiration
- E2 = Gastric inflation
- E3 = Esophageal pressure
- E4 = BMV affected
- E5 = Laryngeal tube ventilation affected
- E6 = LMA insertion or ventilation affected
- E7 = Endotracheal intubation affected
- E8 = size of glottic opening
- E9 = Manikin

*italics = Animal studies*
### Summary of evidence

#### Evidence Neutral regarding Clinical Question

**Studies conducted under anaesthesia or awake volunteers or cadavers or manikins**

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- **Lawes, 1986 p1376 E9**

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*Italics = Animal studies*

#### Evidence Opposing Clinical Question

**Studies conducted under anaesthesia or awake volunteers or cadavers or manikins**

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- **Allman, 1995 p197 E4**
- **Brimacombe, 1993 p800 E6**
- **McNelia, 2007 p456 E7**
- **Hartsilver, 2000 p208E4**
- **Hocking, 2001 p828 E4**

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*Italics = Animal studies*
REVIEWER’S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

The studies, with few exceptions, were carried out on patients undergoing anaesthesia. Virtually all patients in these studies were ASA level 1 or 2 and had been fasting... a population quite different from patients experiencing cardiac arrest. All studies must be extrapolated to be applied to resuscitation. (i.e. LOE 5)

Some studies addressed aspiration indirectly:
1) regurgitation risk is increased by gastric inflation therefore, if cricoid pressure prevents or reduces gastric inflation, regurgitation risk (and perhaps regurgitation) is decreased. Gastric inflation with BMV is affected by inflation pressures which in turn are determined by inflation volume and inflation duration. The data clearly shows that cricoid pressure does reduce gastric inflation however the ventilation volumes used in these studies exceeds volumes currently recommended in cardiac arrest.
2) a high lower esophageal sphincter pressure (LESP) reduces regurgitation risk by providing a barrier to regurgitation of gastric contents. However a lowering effect of cricoid pressure on LESP in the anesthetized patient is unlikely to be relevant in the patient in cardiac arrest as decreased muscle tone in the arrested patient likely already results in a low esophageal sphincter pressure. (This interpretation is suggested by a paper that reports 3 cases (Gabrielli 2005) where LESP went from normal values of approximately 20 mmHg before arrest to 5 mmHg or less during cardiac arrest.)

Other studies evaluated effects of cricoid pressure on BMV or on intubation. Complete obstruction caused by cricoid pressure was common regardless which ventilation device was used and was more common, the greater the force of the cricoid pressure. Less force by cricoid pressure reduced the incidence of complete obstruction but, as studies of regurgitation conducted on cadavers demonstrate, decreased force of cricoid pressure equates with decreased effectiveness of the cricoid pressure to prevent aspiration. Intubation with the LMA and the laryngeal tube may be impeded or completely prevented by cricoid pressure. Some studies (8) also demonstrate that endotracheal intubation may also be impeded or prevented though other studies (5) fail to demonstrate any impediment.

The only studies that deal directly with regurgitation were conducted on cadavers. Cricoid pressure with 44 Neutons force prevents movement of fluid from the esophagus to the retropharynx in most (but not all) patients. Reducing the force reduces the effectiveness of cricoid pressure. Case series and case reports of patients undergoing intubation demonstrate that aspiration occurs despite application of cricoid pressure.

Models were used in all 21 studies that evaluated current practice and the effect of training. Healthcare providers who use cricoid pressure regularly or who work in a situation where they may be required to use cricoid pressure are generally unable to judge the amount of force they apply. A majority of the providers tested used too little or too much cricoid pressure. Even after training, the ability of providers to judge the amount of force required was low and the number of applications outside the recommended range was substantial.

In Summary:
There is little evidence that cricoid pressure is effective in preventing regurgitation in patients undergoing anaesthesia. There is some evidence that cricoid pressure may reduce the likelihood of regurgitation by reducing gastric inflation but other evidence that the application of cricoid pressure may predispose to regurgitation by lowering LESP. There is ample evidence that cricoid pressure is poorly applied both by providers who have a high likelihood of needing to use the procedure (OR nurses, anaesthetic assistants, etc), and by those who consider themselves experts (anesthesiologists). Training improves performance but many failures still occur.

There is no data that addresses the use of cricoid pressure in cardiac arrest. Given the paucity of evidence for benefit in anaesthesia, the high rate of interference with ventilation or intubation, and the low rate of correct application by providers who use the procedure frequently or who have a high likelihood of having to use the procedure, and the documented failure of cricoid pressure to prevent aspiration, cricoid pressure for use in cardiac arrest cannot be recommended.
Acknowledgements:

Annotated List

**Aspiration**


**Level 5**: CADAVER
Quality: fair
Support: positive

30 to 150 ml of fluid was introduced into the stomach of 5 cadavers. Cricoid pressure not measured - described as "firm". Intra-gastric pressures of 50 to 96 cm H2O were required to overcome the effects of cricoid pressure. The author points out that other studies demonstrate that typical pressure in the fasted patient is less than 20 cm H2O. Whether ventilation was possible was not assessed.


**Level 2**: prospective comparison
Quality: poor
Support: neutral

Prospective observational study of 4891 c-sections involving intubation. Cricoid pressure in 61%, aspiration in 0.8% (24). No cricoid pressure in 39%, aspiration in 0.3% (6).

Potential biases: 1) 18% of anaesthetists doing 12% of cases had no training 2) it may have been the higher risk patients who received CP 3) CP may have been claimed to have been provided in patients who regurgitated


**Level 4**: Case series
Quality: poor
Support: neutral

Retrospective review of 240 self-reported cases of possible aspiration during anesthesia from an Australian incident-monitoring database (5000 reports). There were 133 cases of aspiration according to the study criteria. Possible aspiration occurred in 14/240 (6%) cases when cricoid pressure was applied and aspiration occurred in 11/133 (8%) cases when cricoid pressure was applied. It is unclear whether cricoid pressure was indicated (according to the study authors) in 33/133 or 44/133 of the cases of aspiration. It is clear that cricoid pressure failed to prevent aspiration in 11 patients.


**Level 4 - CASE**
Quality: poor
Support: positive

21 year old 75 kg man – RSI then intubation – when cricoid pressure was released following intubation stomach contents appeared in the mouth.

Level 4 - CASE
Quality: poor
Support: negative


Level 5: CADAVER
Quality: fair
Support: positive
PED

Study on 8 infant cadavers found cricoid pressure to be effective in preventing reflux of gastric material into the pharynx in the presence or absence of a nasogastric tube despite an intra-oesophageal pressure of 100 cm H2O. Cricoid pressure was not measured - described as "firm". Whether ventilation was possible was not assessed.


Level 5: CADAVER
Quality: fair
Support: positive

The oesophagus' of 6 cadavers was distended with saline to 75 mmHg and found that 'firm' CP prevented regurgitation. When pressure was released regurgitation occurred in all. Cricoid pressure was not measured - described as "firm". Whether ventilation was possible was not assessed.


Level 4: case series
Quality: Good
Support: Opposing

This prospective case series included 297 critically ill adults. 277 patients had post-intubation xray. 12 patients (4%) had an unexplained infiltrate on xray that probably resulted from aspiration during airway management. Nine of the 12 patients had cricoid pressure applied during airway management; 3 did not.


Level 4 - case series
Quality: poor
Support: positive

Cricoid pressure was used on 26 anesthetized patients. 23 patients had no regurgitation while 3 had regurgitation into the pharynx immediately on release of cricoid pressure after intubation “suggesting that in these 3 cases, cricoid pressure had been effective.”


Level 5: CADAVER
Quality: good
Support: positive
Cricoid pressure of 43 N was applied to 10 cadavers after laryngeal mask insertion. Cricoid pressure prevented reflux. Ability to ventilate with cricoid pressure was not assessed.


Level 4 - CASE
Quality: poor
Support: positive

Tracheal intubation was achieved through the laryngeal mask airway, in a patient with unexpected difficult airway, while regurgitation was prevented with continuous cricoid pressure. Regurgitation occurred after cricoid pressure was released.


Level 4: Case series
Quality: Poor
Support: Opposing

Retrospective chart review determined that 3/85 patients undergoing urgent intubation, all with cricoid pressure, aspirated.


Level 5: CADAVER
Quality: good
Support: positive

Cricoid pressure of 30 N prevented regurgitation with esophageal pressures up to 40 mmHg in 10/10 cadavers.


Level 4: Cases
Quality: poor
Support: opposing

2 cases of aspiration during induction while cricoid pressure was being applied.


Level 4: case
Quality: poor
Support: opposing

Case reports of cricoid pressure applied before anaesthesia causing hiccough followed by regurgitation and aspiration and a second case where cricoid pressure obliterated the view of the glottis. Also “told of a case when pharynx was full of fluid despite properly applied cricoid pressure.”

Gastric inflation


Level 2: pro compare
Quality: poor
Support: positive

_Gastric inflation was tested by auscultation in patients undergoing anaesthesia both with and without cricoid pressure. When cricoid pressure was applied in patients with a patent airway, gastric inflation was not detected. The authors do not comment on how much air can enter the stomach without detecting gastric inflation by auscultation._


**Level 2: pro compare**
**Quality:** poor
**Support:** positive
**PED**

_Prospective comparison of the effectiveness of cricoid pressure to prevent gastric insufflation in pediatric patients. “Appropriate cricoid pressure” was applied in all patients by one individual... the same individual who determined whether gas was entering the stomach (detected by auscultation or by Doppler). Gas was not detected entering the stomach in any patient._


**Level 1: RCT**
**Quality:** good
**Support:** positive (for gastric insuff)

**Random allocation of 50 patients undergoing anaesthesia and being ventilated with a bag-mask to cricoid pressure or no cricoid pressure demonstrated less gas in the stomach with cricoid pressure for patients who were easy to ventilate.**


**Level 2: pro compare**
**Quality:** good
**Support:** positive
**PEDS**

_BMV was performed with and without cricoid pressure. Gastric inflation was significantly greater without cricoid pressure. Gastric inflation was measured by NG tube._

_Esophageal sphincter pressures_


**Level 5: prospective comparison**
**Quality:** good
**Support:** opposing

_Cricoid pressure applied to pigs under anaesthesia reduced lower esophageal barrier pressure from mean of 13.7 mmHg to 9 mmHg_  


**Level 2: pro compare**
**Quality:** good
**Support:** opposing
Lower esophageal pressure was measured during and without application of cricoid pressure in 30 volunteers undergoing elective surgery. Pressure decreased from a mean of 17 mmHg to 12 mmHg. Mean esophageal barrier pressure was reduced by 44%.


Level 2: pro compare
Quality: good
Support: opposing

The effect of 30 N cricoid pressure, with and without remifentanil and propofol, on lower esophageal sphincter pressure was studied in 10 healthy awake volunteers. Cricoid pressure significantly reduced lower esophageal sphincter pressure. There was no statistical difference in LESP when drugs were administered before applying cricoid pressure. The effect of cricoid pressure on LESP in cardiac arrest cannot be inferred from this study.


Level 2: pro compare
Quality: good
Support: opposing

Lower esophageal sphincter pressure was measured on 8 unanaesthetized volunteers to evaluate the effect of cricoid pressure. Cricoid pressure at 40 N decreased lower esophageal pressure from 24 +/- 3 mmHg to 12 +/- 4 mmHg.


Level 2: pro compare
Quality: fair
Support: positive

Upper esophageal sphincter pressure was measured with and without cricoid pressure in 24 patients undergoing elective general anaesthesia. Awake upper esophageal sphincter pressure was a median of 38 mmHg. Cricoid pressure of 40 N produced an upper esophageal sphincter pressure above 38 mmHg in all the patients.

**Glottic Opening**


LOE 2: prospective comparison
Quality: Fair
Support: Opposing

The effect of cricoid pressure was assessed by photographing laryngoscopic view of the glottic opening in 40 patients undergoing elective anasthesia. 5/40 showed marked deterioration of view with increasing pressure. In 3/40 the view was completely obscured at 30 and 40N.


LOE 2: prospective comparison
Quality: fair
Support: opposing
The size of the rima glottides of 12 patients undergoing elective anesthesia was assessed with and without application of cricoid pressure. 20 and 30N of cricoid pressure significantly reduced the size of the opening. 1/12 had size reduced to 1mm with 30N cricoid pressure.

**BVM**


Level 1: RCT  
Quality: Good  
Support: opposing

Cricoid pressure on ASA 1 patients undergoing elective surgery by experienced anaesthetists caused decrease in tidal volume and increase in peak inspiratory pressure overall and complete obstruction in 11%  


Level 4: case  
Quality: poor  
Support: opposing

Case of 27 year old woman undergoing c-section. Impossible to intubate or to ventilate with bag-mask unless cricoid pressure was fully released.


Level 1: RCT  
Quality: Good  
Support: opposing

RCT in elective surgery patients undergoing anaesthesia assessing airway obstruction without and with various types and force of cricoid pressure. Airway obstruction did not occur without cricoid pressure, occurred in 1/52 patients with 30N cricoid pressure and in 18/52 patients with 44N cricoid pressure.


Level 4: case  
Quality: poor  
Support: opposing

2 cases of “excessive” cricoid pressure causing airway obstruction and impeding intubation.


Level 1: RCT  
Quality: Good  
Support: opposing
RCT using cricoid pressure vs no cricoid pressure in different positions on elective surgery patients undergoing anaesthesia. Significant increase in peak expiratory pressure and decrease in tidal volume with cricoid pressure. Complete obstruction occurred with cricoid pressure in 2/50 supine with cricoid pressure and 1/50 lateral with cricoid pressure.


Level 4: case
Quality: poor
Support: opposing

Cricoid pressure caused complete airway obstruction in 3/20 with gastric insufflation in 1 of the 3


Level 2: pro compare
Quality: Good
Support: opposing

Cricoid pressures of 20, 30 and 44 N applied with a cricoid yoke were assessed in 30 anaesthetized patients. 43%, 50%, and 90% of patients had cricoid occlusion at each of the pressures respectively. 50% of patients had difficulty in ventilation and 60% had vocal cord occlusion at pressures up to 44N.


Level 1: RCT
Quality: Fair
Support: opposing

Random allocation of 50 patients undergoing anaesthesia and being ventilated with a bag-mask to cricoid pressure or no cricoid pressure caused complete airway occlusion in 3/50


Level 4: case
Quality: poor
Support: opposing

Case report of cricoid pressure causing airway obstruction that then required a surgical airway in a patient with undiagnosed traumatic injury to the larynx.

Laryngeal Tube


Level 1: RCT
Quality: Fair
Support: opposing

Adequacy of ventilation, time to adequate ventilation, and the leak pressure were assessed in RCT trial of LT and LTS following insertion with cricoid pressure or sham pressure. Ventilation adequate in 6/25 and 5/15 with cricoid pressure and in 25/25 and 15/5 without cricoid pressure. Time to insertion and leak pressure worse when inserted with cricoid pressure.

LMA


Level 1: RCT
Quality: Fair
Support: opposing

Small number of elective surgery patients. LMA successfully inserted in 19/22 without cricoid pressure and 3/20 with cricoid pressure. LMA insertion successful in 17/17 failed intubations after cricoid pressure released.


Level 1: RCT
Quality: Fair
Support: opposing

Ventilation successful after LMA insertion in 5/20 elective surgery patients with cricoid pressure and 20/20 without cricoid pressure. Position of the LMA assessed fiberoptically and by XR showed malposition.


Level 1: RCT
Quality: Fair
Support: opposing

Block randomized, double blinded. LMA insertion and adequate ventilation with cricoid pressure 10/20 vs 19/20 without cricoid pressure in elective surgery patients. LMA in correct position in 2/20 with and 16/20 without cricoid pressure.


Level 1: RCT
Quality: Fair
Support: opposing

RCT of LMA insertion in elective surgery patients with and without standardized pressure of 30N by cricoid yoke. Ventilation successful after LMA insertion in 22/22 without cricoid pressure and 3/22 with cricoid pressure.

Level 1: RCT  
Quality: Fair  
Support: supporting

RCT in 100 elective patients undergoing anaesthesia allocated to cricoid pressure or no cricoid pressure. LMA insertion was unaffected by cricoid pressure.


Level 1: RCT  
Quality: Good  
Support: opposing

RCT of LMA insertion with and without cricoid pressure in elective patients undergoing anaesthesia. Successful insertion in 49/50 without and 45/50 with cricoid pressure.


Level 4: Case  
Quality: Poor  
Support: opposing

Case report of vocal chords closing when cricoid pressure applied and LMA in place.


Level 2: Prospective Comparison  
Quality: Fair  
Support: opposing

LMA insertion with in-line stabilization of the neck with and without cricoid pressure in 40 patients undergoing elective surgery was studied. The LMA was easily inserted in 33/40 on first attempt and 7/40 when insertion technique was modified. With cricoid pressure LMA was successful on first attempt in 14/40 15/40 required a modified insertion technique and in 11/40 insertion was either not possible or once inserted failed to function.


Level 2: Prospective Comparison  
Quality: Good  
Support: opposing

Cricoid pressure applied in 50 anaesthetized patients impeded correct insertion of LMA as determined by lung ventilation scores, anatomic position scores, and airway seal pressure.

Level 2: Prospective comparison
Quality: Good
Support: opposing

Insertion of PLMA was performed with cricoid pressure in 50 patients undergoing elective anaesthesia. Cricoid pressure significantly impeded insertion of the PLMA in 36/50 patients.

Endotracheal Intubation


Level 1: RCT
Quality: Fair
Support: opposing

Block randomized, double blinded. Fiberoptic aided intubation through LMA successful in 19/20 without cricoid pressure and 3/20 in cricoid group. After release of cricoid pressure intubation difficult due to laryngeal deviation.


Level 1: RCT
Quality: fair
Support: opposing

RCT of tracheal intubation through LMA over fibrescope with and without cricoid pressure AFTER LMA insertion -- was successful in 31/35 with sham cricoid pressure and 21/35 with cricoid pressure.


Level 1: RCT
Quality: fair
Support: positive

RCT of intubation over fibrescope with and without cricoid pressure. Tracheal intubation was successful within 60 s in 7/21 patients (33%) without cricoid pressure, compared with 12/19 patients (63%) when cricoid pressure was applied.


Level 1: RCT
Quality: fair
Support: opposing

RCT examined intubation through an intubating laryngeal mask with and without cricoid pressure in elective surgery patients undergoing anaesthesia. Intubation was successful in 21/25 without cricoid pressure and in 13/25 with cricoid pressure.

Level 2: pro compare
Quality: fair
Support: opposing

Non-randomized prospective comparison of intubation though an LMA with and without cricoid pressure in elective surgery patients undergoing anaesthesia. 45/50 intubated without cricoid pressure, 28/50 intubated with cricoid pressure.


Level 4: case
Quality: poor
Support: opposing

2 cases of “excessive” cricoid pressure causing airway obstruction and impeding intubation


LOE 4: Case series
Quality: good
Support: supporting

While this is a RCT, the comparison groups are different methods of cricoid pressure: There was no comparison to no cricoid pressure. For purposes of this review, the study was therefore classified as a case series. Cricoid pressure caused no difficulty with intubation.


Level 5: cadaver
Quality: good
Support: opposing

This study on cadavers compared percentage of glottic opening with 4 manipulations. Cricoid pressure worsened laryngoscopy in 409/1530 (29%) applications.


Level 1: RCT
Quality: fair
Support: positive

RCT conducted with 70 anaesthetized patients. Laryngoscopic view improved with cricoid pressure in up to 26% of supine patients and in up to 30% of patients in the left lateral position and worsened it in none.

Gum elastic bougie facilitated intubation was examined in 120 patients who were randomized to cricoid pressure or sham cricoid pressure. Impingement occurred in 63% and 38% with and without cricoid pressure. Intubation was successful following tube rotation in 100% of subjects who received sham cricoid pressure and in 89% of subjects who received cricoid pressure.


RCT assessing ease of intubation facilitated by gum elastic bougie or malleable stylet while applying cricoid pressure in patients undergoing anaesthesia. Applying cricoid pressure worsened laryngeal view.


33 patients undergoing elective anaesthesia were intubated randomly both with and without cricoid pressure. Full visualization of the glottis and no compression of the vocal chords occurred in 91% without cricoid pressure and 67% with cricoid pressure. Intubation was impeded in 15% of patients and could not be performed without releasing cricoid pressure in 9%.


The laryngoscopic view of 43 patients undergoing elective anaesthesia was assessed with and without cricoid pressure. Cricoid pressure worsened the view in 12.5%


700 adult patients undergoing elective general anaesthesia were randomly assigned to have a standardized cricoid pressure (n = 344) or a sham cricoid pressure (n = 356) during laryngoscopy and intubation. The rates of failed intubation and time to intubation between the groups were not significantly different.

Level 1: RCT  
Quality: fair  
Support: positive

Standard cricoid pressure at 30 N was randomly compared to upward backward cricoid pressure at 30 N in 50 female patients undergoing elective general anaesthesia. Both types of cricoid pressure gave a better view than no cricoid pressure.


Level 4: case  
Quality: poor  
Support: opposing

Case reports of cricoid pressure applied before anaesthesia causing hiccough followed by regurgitation and aspiration and a second case where cricoid pressure obliterated the view of the glottis. Also “told of a case when pharynx was full of fluid despite properly applied cricoid pressure.”

Training/Testing


Level 5: model  
Quality: fair  
Support: opposing

49 anaesthetic assistants and anaesthetists assessed on application of cricoid pressure at 20 and 40 N. 63% applied inadequate pressure. 18 of these received training session with improvement. After 14-21 days improvement retained by 72%.


Level 5: MODEL  
Quality: fair  
Support: Opposing

In this descriptive study, 5/26 nurses with varying clinical experience and who had had training in cricoid pressure within 6 months of the study were ably to apply cricoid pressure within the appropriate target range.


Level 5: model  
Quality: good  
Support: opposing
Emergency physicians (38) and nurses (69) demonstrated cricoid pressure on a model in prospective observational study. 25% applied 30-40 N, 47% applied less force and 28% applied more force. 12/107 correctly identified the target range and 3/12 applied force within that range. 24/95 who incorrectly identified the target range applied force within the target range.


Level 5: model
Quality: fair
Support: positive

After practice, 63% of nurses were able to apply cricoid pressure within target range and using a floor scale during cricoid pressure increased successful performance to 95%. In no case was force entirely outside target range using floor scale method.

Level 5: model
Quality: fair
Support: opposing

40 nurses applied cricoid pressure to a model for 1 minute. In 35% of subjects, cricoid pressure was applied outside of desired force range for entire time of test period and in an additional 43%, cricoid pressure was applied outside of desired range for some portion of the test period. 25% applied forces of >40 N and 18% applied force of less than 20 N.


LOE 5: Model
Quality: Good
Support: Opposing

Medical students and nursing staff were randomized to receive cricoid training with and without force feedback. Large numbers of both groups were unable to provide adequate cricoid pressure following training.


Level 5: model
Quality: fair
Support: opposing

25 anaesthetists, OR nurses and OR technicians were examined as to their ability to apply 20 and 40 N of cricoid pressure to a model before and after training. Fewer than half were able to apply target pressure before training. 96% were able to apply target force immediately post training, ~2/3 retained this ability at 1 week but after 1 month there was no significant difference between pre and post training ability.


Level 5: model
Quality: fair
Support: positive (rated positive because knowledge retained after training but could have rated negative because of universal inability to apply appropriate pressure in practitioners using the procedure regularly)
53 MDs, residents, and nurse anaesthetists applied cricoid pressure to a model. Before instruction 53/53 applied inadequate pressure. After instruction all applied recommended pressure immediately and at 3 months.


Level 5: model
Quality: fair
Support: opposing

Anaesthetists and OR staff who use cricoid pressure performed cricoid pressure on a model. There was a large variation in force applied. A large proportion did not achieve effective pressure and a large proportion applied excessive pressure.


Level 5: model
Quality: fair
Support: positive

36 anaesthesia assistants were assessed in application of cricoid pressure on a model. 10/36 applied target pressure before training, 36/36 after.


Level 5: model
Quality: good
Support: opposing

Practising anaesthetic assistants or operating department practitioners, with regular experience in the clinical application of cricoid pressure were randomized to pre-test training or no pre-test training group. No training group applied satisfactory force 6/32, training group applied satisfactory force in 15/32.


Level 5: model
Quality: fair
Support: opposing

Peri-operative nurses performed cricoid pressure on a model. 13% applied correct pressure, 69.5% applied too little pressure, 17.5% applied excessive pressure.


Level 5: model
Quality: fair
Support: neutral
Medical personnel who were experienced and novice with cricoid pressure application applied cricoid pressure to a model manually and with a cricoid yoke. Some of the subjects applied insufficient pressure manually but none of the subjects applied insufficient pressure with the cricoid yoke. Some of the subjects applied excessive pressure both manually and with the cricoid yoke.


Level 5: model
Quality: good
Support: opposing

110 critical care staff practiced applying cricoid pressure of 30-40 N on a model. While practice improved the ability to apply cricoid pressure within the target range and at forces sufficient to prevent regurgitation, and decreased excessive pressure, many subjects applied potentially harmful or ineffective cricoid pressure both before and after practice.


Level 5: model
Quality: fair
Support: opposing

Simulated sustained cricoid pressure on a model for 20 minutes was studied in 6 operating department assistants. None of the subjects was able to sustain 40 N for the target time. Mean times to release at 40 N were: flexed position 3.7 min, extended position 7.6 min.


Level 5: model
Quality: good
Support: opposing

135 anaesthetic assistants applied cricoid pressure to a model before information and instruction, after information and after information and instruction. 55/135, 86/135, and 96/135 applied pressure within the target range respectively.


Level 5: manikin
Quality: fair
Support: positive

90% of 50 trained and experienced staff applied cricoid pressure effectively following additional training and specific practice

Level 5: model
Quality: fair
Support: opposing

5% of 50 trained and experienced staff who regularly apply cricoid pressure applied cricoid pressure effectively without training
Patten SP. Educating nurses about correct application of cricoid pressure. AORN J. 2006;84(3):449-61.

Level 5: model
Quality: fair
Support: opposing

This study to assess the effectiveness of cricoid pressure application by 51 perioperative nurses increased the proportion of participants who were able to apply an appropriate amount of pressure 2/51 to 35/51 after and education program designed to improve performance.


Level 5: model
Quality: fair
Support: opposing

70 ED physicians and nurses who volunteered to participate were pseudorandomized to a training or an education group. All participants then demonstrated correct cricoid pressure on a model at baseline, immediately after training or education, and 4-6 weeks after training or education. Baseline/post-intervention/4-6 wk performance was 38%/88%/67% respectively in the training group, compared with 30%/33%/51% in the education group.


Level 5: model
Quality: fair
Support: opposing

48 physicians, nurses and nurse assistants applied cricoid pressure to a model for 60 seconds. 25th percentile of force applied was 26N and 75th percentile was 50N.


Level 5: model
Quality: fair
Support: opposing

34 physicians and nurses applied cricoid pressure to a model. 9/34 applied cricoid pressure correctly at baseline, 25/34 immediately following practice and 9/34 at 1 month after practice.


Level 5: model
Quality: fair
Support: opposing

Of 43 anaesthetic assistants and junior anaesthetists tested on a model, 28% applied cricoid pressure of 30-40 N, 52% applied cricoid pressure less than 30 N, and 21% applied cricoid pressure of greater than 65N.
Citation List

Aspiration

Gastric inflation

Esophageal sphincter pressures

**Glottic Opening**

**BMV**

**Laryngeal Tube**

**Laryngeal Mask Airway**

**Endotracheal Intubation**


**Test of Performance/Training**


17. Patten SP. Educating nurses about correct application of cricoid pressure. AORN J. 2006 Sep;84(3):449-61.


Review or Editorial or Commentary:


Rejected
44. Cook TM. Cricoid pressure--one or two hands? Anaesthesia. 1997 Dec;52(12):1238-9.
84. Heath ML. Endotracheal intubation through the Laryngeal Mask--helpful when laryngoscopy is difficult or dangerous. Eur J Anaesthesiol Suppl. 1991;4:41-5.
89. Hofman N. Cricoid pressure not protective in patients that have undergone esophagectomy. Anesth Analg. 2007 May;104(5):1303; author reply


118. Lerman J. Is cricoid pressure necessary? Paediat Anaesth. 2002 Sep;12(7):655; author reply


123. Ma GPJH, Yentis SM. Cricoid pressure application to awake volunteers: Discomfort cannot be used to indicate appropriate force [5]. Canadian Journal of Anaesthesia. 2005;52(1):114-5.


148. Palmer JHM, Ball DR. The effect of cricoid pressure on the cricoid cartilage and vocal cords: An endoscopic study in anaesthetised patients. Anaesthesia. 2000;55(3):263-8. (effect of cricoid pressure viewed through LMA. CP caused cricoid occlusion and difficulty with ventilation but cannot exclude LMA as cause of observed effects. Likely would cause difficulty with or prevent intubation but not tested.)


150. Parish M, Mahmoudpoor A. Cricoid pressure is for full stomachs, thyroid pressure is for assisting intubations [27]. Anesthesia and Analgesia. 2007;104(1).


163. Roth JV. Cricoid pressure is for full stomachs, thyroid pressure is for assisting intubations. Anesth Analg. 2007 Jan;104(1):219; author reply


168. Sakai T, Planinsic RM, Hilmi II. Cricoid pressure not protective in patients that have undergone esophagectomy [24]. Anesthesia and Analgesia. 2007;104(5).


176. Shirley P. Cricoid pressure training; where to from here? Anaesth Intensive Care. 2004 Feb;32(1):145; author reply


188. Smith B. Cricoid pressure--increased interest. J Perioper Pract. 2006 Apr;16(4):161; discussion