

Cricoid pressure: Where do we stand?

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Abstract

In 1961, Sellick popularized the technique of cricoid pressure (CP) to prevent regurgitation of gastric contents during anesthesia induction. In the last two decades, clinicians have begun to question the efficacy of CP and therefore the necessity of this maneuver. Some have suggested abandoning it on the grounds that this maneuver is unreliable in producing midline esophageal compression. Moreover, it has been found that application of CP makes tracheal intubation and mask ventilation difficult and induces relaxation of the lower esophageal sphincter. There have also been reports of regurgitation of gastric contents and aspiration despite CP. Further, its effectiveness has been demonstrated only in cadavers; therefore, its efficacy lacks scientific validation. These concerns with the use of CP in modern anesthesia practice have been briefly reviewed in this article.

Key words: Anesthesia, cricoid pressure, Sellick maneuver

Introduction

Cricoid pressure (CP) was first described by Monro in 1774, when he used it in drowning victims to prevent gastric distention.^[1] No other mention of the technique occurred until 1961 when Sellick^[2] popularized this procedure to prevent regurgitation of gastric contents during anesthesia induction. In his original description Sellick stated that “the maneuver consists of temporary occlusion of the upper end of the esophagus by backward pressure of cricoid cartilage against bodies of cervical vertebrae” Sellick’s this report transformed the practice of anesthesia and CP became an integral part of rapid sequence induction. However, this investigation had some major flaws.^[3-6]

It was a non-randomized, uncontrolled case series. Each patient in this report was positioned “head down slightly with head turned” for induction of anesthesia. Fear of regurgitation and aspiration during anesthesia induction with earlier ether

anesthetics had led to this positioning. Upon release of CP Sellick noted that three patients (12%) regurgitated.

Readers might attribute the high incidence of regurgitation in Sellick’s report to the patients head down position, which is currently never used during anesthesia induction. Moreover, except for the statement that an “intravenous-barbiturate/muscle relaxant technique permits rapid intubation and is the method of choice,” there is no further reference to either sequence of administration/dosage of anesthetic drugs used for induction of anesthesia. It is therefore impossible to judge the quality of anesthesia induction and whether this was comparable between those patients who did and did not regurgitate. Further, in his report Sellick suggested that firm pressure be applied to the cricoid by a nurse/midwife accompanying the patient, who can be shown in a few seconds how to apply CP. He however, never determined how much force was required. Moreover, the force applied during CP could have varied considerably between patients as it was applied by untrained personnel.

Despite these major limitations, this technique was rapidly and rather uncritically adopted by anesthetists all over the world.

In the last two decades, clinicians have begun to question the efficacy of CP and therefore the necessity of this maneuver. Some have suggested abandoning it on the grounds that the esophagus is not exactly posterior to cricoid and thus the maneuver is unreliable in producing midline esophageal compression. Moreover, it makes tracheal intubation and mask ventilation difficult and induces relaxation of the lower

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esophageal sphincter. There have been reports of regurgitation of gastric contents and aspiration despite CP. Further, its effectiveness has been demonstrated only in cadavers; therefore, its efficacy lacks scientific validation.^[4,7]

Does CP Occlude the Esophagus?

Crucial to the postulated effectiveness of CP is conclusive demonstration that cricoid cartilage, esophagus and vertebral bodies are normally juxtaposed along the axial plane and backward pressure of cricoid cartilage against cervical vertebrae does, indeed, occlude the esophagus.^[6]

However, Vanner and Pryle^[8] on studying computed tomography (CT) scans during application of CP, demonstrated lateral displacement of esophagus. In agreement with this finding, a retrospective review of 51 cervical CT scans^[9] and prospective analysis of 22 cervical magnetic resonance imaging (MRI) scans,^[10] revealed some degree of lateral displacement of the esophagus relative to the midline of the vertebral body in 49% and 53% respectively, even in the absence of any CP. Application of CP increased incidence of lateral displacement of the esophagus from 53% to 91%.

In order to shed light on the efficacy of CP and to accurately define the anatomy of CP maneuver, Rice *et al.*^[11] studied the MRI of 24 adult volunteers with and without CP. Measurements were made of the post-cricoid hypopharynx, airway compression and lateral displacement of the cricoid ring during application of CP. They found that it was the hypopharynx and not the esophagus that was present behind the cricoid ring and was indeed compressed by CP. When cricoid cartilage moved laterally with respect to the vertebral body as was observed in 17-33% of the applications of CP, the hypopharynx and cricoid moved together as a unit, called the CP unit and in this lateral position post-cricoid hypopharynx was compressed between the cricoid ring and longus colli muscle group. They also found that previously reported lateral movement of the esophagus from the midline when CP was applied, undoubtedly occurred, but the origin of the esophagus was inferior to the level of cricoid cartilage and thus was not relevant to the efficacy of Sellick's maneuver. They thus confirmed Sellick's original proposal that CP does compress the conduit between the stomach and pharynx as intended.

Does CP Cause Problems With the Airway?

There have been numerous published articles, with contradictory results, reporting the effect of CP on laryngeal view and tracheal intubation.^[12] There have been reports that CP may alter the upper airway anatomy and compromise its

patency.^[13] A randomized study in 2003 by Noguchi *et al.*,^[14] designed to examine the effect of CP on passing a bougie, found that CP significantly worsened the laryngeal view and a study combining laryngoscopy, CP force measurement and endoscopic photography down the laryngoscopic blade found that 8 of 40 patients had marked deterioration of laryngeal view.^[15] There also have been reports that CP interferes with laryngeal mask airway (LMA) placement and advancement of tracheal tube, makes ventilation with facemask/LMA difficult and alters laryngeal visualization by flexible bronchoscope.^[12]

However, a randomized study by McCaul *et al.*,^[16] designed to examine airway management in lateral position reported an improvement in laryngeal view with CP in both lateral and supine positions. Turgeon *et al.*^[13] conducted a large, randomized, double-blinded, controlled trial using 30N of CP and found no appreciable effect on tracheal intubation success, laryngeal view or time to tracheal intubation. This discrepancy could be explained by frequent use of less than optimal technique for application of CP in the usual clinical setting. Indeed, it has been reported that anesthesia personnel have limited knowledge of CP. In a survey done in England, 220 professionals were asked about the adequate force to be used in CP. Answers varied from 1-44N for awake and 2-80N for unconscious patients. Many did not know the force applied or described it as "enough," "enough force to break an egg" or "varies."^[17]

Traditional teaching of the required force has been 44N and often the applied force is even more than this. This force was recommended by Wraight *et al.*^[18] as a cricoid force that would prevent regurgitation with a theoretical maximum gastric pressure of 59 mm of Hg in 50% of patients. However, it has been found that excessive force, especially > 40N, can compromise airway patency and cause difficulty with tracheal intubation.

Can Less CP Force Prevent Regurgitation?

Previous studies have shown that gastric pressures are generally < 25 mm of Hg in supine position under general anesthetics (GA), even during the emergency cesarean section with a full stomach. Although suxamethonium fasciculations can increase gastric pressure, peak pressure is still rarely >25 mm of Hg.^[19] Wraight *et al.*^[18] have shown that 34N occluded a manometry catheter behind the cricoid cartilage at pressure >30 mm of Hg in all patients. In another study, by Vanner *et al.*,^[20] cricoid force of 30N occluded the manometry catheter with a pressure >25 mm of Hg in all patients.

Based on the various previous reports, a reasonable recommendation would be to apply 10N of force to the

cricoid cartilage in an awake patient and to increase this force to 30N once the patient loses consciousness.^[19] Moreover, it can be presumed that excessive force, wrong direction of force or more importantly, application of pressure on larynx rather than cricoid ring would make visualization of the larynx and intubation difficult.

Does CP Reduce the Incidence of Regurgitation and Hence Pulmonary Aspiration? What Is Its Scientific Validation?

Evidence to support the assumption that CP is effective, is almost exclusively based on cadaver studies and case reports of regurgitation seen on release of CP after tracheal intubation.^[7] Compelling evidence supporting the effectiveness of CP comes from studies that unequivocally demonstrate its efficacy in preventing gastric inflation in anesthetized children and adults.^[4] It is inconceivable that a maneuver effective in preventing gastric inflation during manual ventilation would not be effective in preventing esophageal contents from reaching the pharynx.

There have been two systemic reviews in the past that concluded that there was no evidence for or against the application of CP.^[3] Three reviews on rapid sequence induction and CP have all pointed out that there are no published randomized controlled trials comparing the incidence of regurgitation on induction, with and without CP in patients at high risk of regurgitation.^[12,21,22]

Because of ethical considerations, such a controlled study is not feasible. Even if such a study were conducted, given the low incidence of pulmonary aspiration, it would yield little information.

If There Is Insufficient Evidence Confirming the Efficacy of CP, Is There Any Evidence That It Has Neutral/Negative Effect on Patient Outcome?

Evidence that CP is not effective comes mainly from reports of regurgitation despite the application of CP.^[7] Moreover, in a review of almost 5000 general anesthetics for obstetrics in Malawi,^[23] 11 deaths were attributed to regurgitation and nine had CP applied. It has been suggested that pulmonary aspiration despite CP may reflect concomitant reflex relaxation of the lower esophageal sphincter. However, this suggestion is unlikely as the purpose of CP is to prevent gastric contents from reaching the pharynx, not to prevent gastro-esophageal reflux.^[4] Moreover, the notion that aspiration may occur despite the application of CP might be reconciled by the fact that a

fixed failure rate may exist even when CP is properly applied. There is also a probability that CP is not applied properly, is released prematurely or aspiration occurs at some time other than induction, i.e., prior to induction or at extubation.^[3]

Nonetheless, a judge in UK did rule against an anesthesiologist for failing to apply the CP in a patient with irreducible hernia who had regurgitated and aspirated. The judge argued that “We cannot assert that CP is not effective until trials have been performed, especially as it is an integral part of anesthetic technique that has been associated with a reduced maternal death rate from aspiration since the 1960’s.”^[7]

Summary

Currently, there is insufficient evidence to advocate or abandon the use of CP to prevent passive regurgitation in at-risk anaesthetized patients. On the other hand, there is solid evidence that CP is applied inconsistently by majority of the practitioners. Indeed, if we are not able to perform it as recommended, whether or not it is a useful technique becomes a secondary argument.

The potential benefits of CP in minimizing gastric distention and possibly lessening the risk of aspiration should be balanced against impaired gas exchange and ventilation. This is best performed on a case-by-case risk-benefit analysis. The risks and benefits of CP are also likely to change not only between patients, but also during a prolonged and problematic tracheal intubation sequence on the same patient. It is important that CP is released if there is any difficulty in either intubating or ventilating the patient.

Conclusion

CP entered medical practice on a limited evidence base, but with common sense supporting its use. Properly applied CP probably is effective at preventing regurgitation on induction of anesthesia, although more randomized controlled trials are awaited to confirm this. Rather than focusing on the documentation that CP was applied during induction of anesthesia, we should try and focus more on investigating the validity of the notion that CP prevents regurgitation, teaching proper technique of CP application, knowing which patients require CP and focusing on the risk of aspiration during maintenance and the emergence from anesthesia.

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