



REVIEW

Cricoid pressure: The argument against

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SUMMARY

Cricoid pressure was introduced in the 1960's to protect patients undergoing general anaesthesia against pulmonary aspiration. Evidence supporting its use was largely based on small cadaver studies, expert opinion and case studies. However, its uptake across the anaesthetic community was universal, perhaps due to the fear of aspiration, but also because it was thought to have little in the way of adverse effects. Recently, the role of CP has been reassessed, with many suggesting its use is no longer warranted, particularly in fully fasted patients. Evidence has shown that not only is CP ineffective in occluding the oesophageal lumen, but it may also interfere with crucial aspects of airway management. Moreover, the ability of medical and nursing staff to perform effective, consistent CP is questionable. However, at present, there is no valid alternative, and the use of CP is therefore likely to continue in selected patients.

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1. Introduction

The effectiveness of cricoid pressure (CP), or Sellick's manoeuvre, to prevent pulmonary aspiration, continues to crystallise opinion within the anaesthetic community.^{1–3} Advocates highlight studies showing a reduction in gastric insufflation and regurgitation with CP applied.³ Others highlight a reduction in the incidence of pulmonary aspiration since it was introduced, particularly in the obstetric population.⁴ However, the fact remains that there is insubstantial evidence to support the use of CP in preventing pulmonary aspiration.^{5,6} On the other hand, there is good evidence that CP interferes with crucial aspects of airway management.⁷ This article will attempt to untangle some of the misconceptions surrounding CP and demonstrate why the argument *against* continues to strengthen.

To do this we will look at three main areas. Firstly, we will look at whether CP reliably occludes the oesophageal lumen. Secondly, we will look at whether it prevents gastric regurgitation and pulmonary aspiration. Finally, we will assess how competently CP is performed in practice and whether it is detrimental to overall

airway management. Before this we will look at the historical inception of CP, which is crucial to understand the ongoing debate.

2. Historical background

In 1961, in response to a growing awareness of the dangers of pulmonary aspiration,⁸ London anaesthetist Dr Brian Sellick advocated the use of a 'simple manoeuvre' to control regurgitation of gastric contents 'until intubation with a cuffed endotracheal tube is completed'.⁹ Sellick suggested that backward pressure on the complete ring-like cricoid cartilage against the 5th cervical vertebra could result in occlusion of the oesophageal lumen, thus preventing regurgitation. He first tested this theory in a cadaver, instilling water into the stomach up to a pressure of 100 cmH₂O, applying a 'firm' pressure to the cricoid cartilage, followed by a steep Trendelenburg position. Sellick found that 'cricoid pressure' prevented water from regurgitating into the pharynx, the flow of which could be controlled by the degree of force used.

In the second phase of his study, he inserted a soft latex tube filled with contrast into the oesophagus of an anaesthetised and paralysed patient. Following the application of CP, lateral neck x-rays were taken which showed loss of contrast at the level of the applied pressure, further confirming his theory. Finally, he went on to study a cohort of 26 high risk patients, all of whom had CP applied at induction of anaesthesia. In three of these patients, he witnessed gastric regurgitation on release of the CP.⁹ Sellick

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conducted another study in 1962 based on a single patient undergoing oesophagectomy under general anaesthesia.¹⁰ Using an endotracheal tube placed in the oesophagus, he demonstrated that CP prevented regurgitation of saline instilled into the oesophagus up to a pressure of 100 cmH₂O.

Significant limitations of the initial studies existed, with Sellick himself acknowledging that these were 'preliminary' findings.⁹ The studies were small, non-randomised and unblinded, with no accurate quantification of the cricoid force used or anaesthetic drugs used. Moreover, those applying the CP were midwives or nurses with 'a few seconds' training. The patients were positioned supine with the head and neck extended in the tonsillectomy position, and a 'slight head down' tilt on the table. In this position, traction on the oesophageal lumen makes it easier to fix against the cervical vertebra, unlike the modern 'sniffing' position. Thus, both the methodology of the study, and the conduct of anaesthesia, varied enormously from current academic and clinical standards.

With minimal scrutiny, widespread uptake of CP occurred across the anaesthetic community. It was adopted as an integral part of a rapid sequence induction/intubation (RSII),¹¹ and quickly became a standard of care for the prevention of pulmonary aspiration. To this day, despite a lack of cohesive evidence, guidelines and experts continue to endorse its use.^{12,13} But will there ever be conclusive evidence? For this we need to take a closer look at the current incidence of pulmonary aspiration and its ramifications.

3. The risk of pulmonary aspiration

In Mendelson's original paper from 1946, the incidence of aspiration in parturients was approximately 1 in 667, with a mortality rate of 1 in 22,000.⁸ This was before the advent of tracheal intubation, when patients underwent facemask anaesthesia with ether and nitrous oxide, and anaesthesia was administered by inexperienced residents. Furthermore, the two patients who died were already said to be critically unwell prior to the aspiration. Studies from Europe and the USA subsequently suggested an incidence of pulmonary aspiration during general anaesthesia that ranged between 1 in 2000¹⁴ and 1 in 3000,¹⁵ with significantly higher estimates in emergency surgery (1:900).¹⁵

Mortality rates in these studies were extremely low, ranging between 1:45,000¹⁴ to 1:70,000,¹⁵ with deaths largely confined to ASA III–IV patients and often a result of failed intubation.¹⁵ More recent estimates from elective surgery suggest the incidence of pulmonary aspiration is even lower (1 in 7000), and mortality as little as 1 in 100,000.¹⁶ Thus, pulmonary aspiration is rare, and mortality from aspiration even rarer. In the elective ASA I–II surgical patient the risk appears to be negligible.⁴ This has led to some suggestions that the use of CP is based on 'exaggerated fear', and by trying to solve 'hypothetical' problems we are simply creating others.¹⁷ What is beyond doubt, is that randomised controlled evidence that either proves or disproves the effectiveness of CP will never be achieved.

4. Does CP occlude the oesophagus?

A number of studies have sought to build on Sellick's original paper to determine whether oesophageal occlusion does occur with cricoid pressure. Of particular debate was the assumption that the oesophagus lies posteriorly to the cricoid ring in the axial plane. A retrospective review of CT scans in healthy individuals showed that in fact the oesophagus sits postero-lateral to the cricoid ring in almost 50% of subjects.¹⁸ These findings were supported in a prospective analysis of 22 awake patients who underwent cervical magnetic resonance imaging (MRI) with and without CP applied.¹⁹ The authors found that CP increased the incidence of lateral

displacement of the oesophagus from 53 to 91%. These studies suggest the degree of oesophageal occlusion with CP is likely to be highly variable.

The significance of these findings have been challenged by Rice et al.²⁰ who studied the MRI scans of 24 individuals with and without CP. They showed that even in the presence of lateral oesophageal displacement, an average 35% (or 3.2 mm) reduction in the AP diameter of the post-cricoid hypopharynx occurred with CP. Although impossible to prove, they argue that this is likely to represent complete occlusion of the hypopharynx lumen. Their findings suggest that it is not the upper oesophageal lumen that is compressed with CP but the post-cricoid hypopharynx. This is significant as the hypopharynx is less mobile than the oesophagus, acting as a continuous anatomical unit with the cricoid ring and cervical vertebra. However, this study was conducted in healthy awake volunteers, the physiology of whom cannot be compared to that of unwell anaesthetised patients. Moreover, as suggested by Lerman, fixing the cricoid ring against a muscular structure, as is the case in the lateral position, is less of a barrier to regurgitation than fixing it against a cervical vertebra.¹

A recent study by Zeidan et al.²¹ attempted to overcome these issues by assessing the ability to pass gastric tubes through the post-cricoid hypopharynx in healthy anaesthetised patients. They found that in all 79 patients, the application of CP at 30N made it impossible to insert a 4 mm gastric tube, with oesophageal occlusion confirmed by video laryngoscopy. They concluded that this provided further visual and mechanical evidence to support the use of cricoid pressure. However, what this study actually achieved was to confirm that when applied by the same fully trained assistant, CP can prevent the regurgitation of particles 4 mm or greater.

5. Does CP prevent gastric regurgitation and aspiration?

Following Sellick's initial work, four studies were conducted, all with similar findings.^{22–25} As with Sellick's study, these studies were small, non-randomised experiments on cadavers, the tissue response of which is incomparable to that of an anaesthetised patient. Prevention of gastric insufflation during facemask ventilation has been used as a surrogate outcome measure to highlight the benefits of CP. Studies in both children and adults have shown that CP prevents gastric insufflation up to inflation pressures of 60cmH₂O.^{26–29} However, these studies assume a causal link between gastric insufflation and regurgitation, a theory which has never been proven. Moreover, the relevance of these studies to modern anaesthetics is debatable as they were conducted when high tidal volumes and inflation pressures were standard practice. This is no longer the case, and research has shown that facemask ventilation using inflation pressures of less than 15cmH₂O provides adequate ventilation without significant gastric insufflation, in the majority of non-obese individuals.³⁰

Two systematic reviews have since been conducted on CP, both of which showed no evidence for or against its use.^{5,6} Moreover, a number of case reports,³¹ surveys,³² confidential enquiries³³ and national audits¹³ have all shown that aspiration still occurs when CP is performed, with at least 11–14% of anaesthetists having witnessed aspiration during its application.³² In a study of 297 patients undergoing emergency tracheal intubation, 12 patients had a new infiltrate on CXR, nine of which had CP applied.³⁴ In addition, evidence shows aspiration does not only occur at intubation, but frequently during maintenance and extubation.¹³

6. What is the evidence for CP in obstetric anaesthesia?

The debate surrounding the use of CP is often heightened when considering its role in obstetric anaesthesia. As things stand, RSI

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