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Cricoid pressure in contemporary airway management: a structured narrative review and call for competency-based implementation

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Abstract

Cricoid Pressure (CP) remains one of the most debated interventions during rapid sequence induction. Although traditionally used to reduce Pulmonary Aspiration (PA), its effectiveness remains uncertain because of conflicting clinical evidence and considerable variability in its application. This structured narrative review critically evaluates contemporary evidence regarding the anatomical rationale, clinical effectiveness, safety, guideline recommendations, performance errors, simulation-based training, and competency-based education for CP. A comprehensive literature search was conducted in PubMed/MEDLINE, Scopus, and Web of Science through July 2026, including randomized controlled trials, systematic reviews, meta-analyses, anatomical studies, clinical guidelines, and educational research. Current evidence does not conclusively demonstrate that CP reduces pulmonary aspiration, while inappropriate anatomical localization, excessive or insufficient force, incorrect timing, and delayed release may adversely affect airway management. Contemporary guidelines increasingly recommend selective rather than routine use of CP and emphasize prompt release whenever ventilation or tracheal intubation is compromised. Educational evidence consistently demonstrates that simulation incorporating objective force-feedback improves immediate technical performance; however, evidence for long-term skill retention, clinical transfer, and patient-centered outcomes remains limited. A six-stage competency-based simulation training curriculum is proposed

to standardize training, objective assessment, and periodic reassessment of CP performance. The review also discusses opportunities for implementing CPE within Bulgarian medical training.

Key words: cricoid pressure; Sellick maneuver; rapid sequence induction; simulation-based training; healthcare professionals.

Pulmonary Aspiration (PA) is an uncommon complication of Airway Management (AM), but one that anesthesiologists remain particularly concerned about because of its potentially severe consequences. Depending on the nature and volume of the aspirated material, it may lead to chemical pneumonitis, pneumonia, profound hypoxemia, admission to intensive care, or death. Findings from the Fourth National Audit Project further demonstrated that serious Airway Complications (AC) continue to cause substantial morbidity and mortality, particularly when AM takes place in emergency departments and intensive care units.¹ Preventing regurgitation and aspiration therefore remains an important consideration during the induction of anesthesia in patients with an unprotected airway. Cricoid Pressure (CP) was introduced by Brian Sellick in 1961 as a simple means of preventing regurgitated gastric contents from reaching the pharynx during induction.² Despite being based initially on cadaveric observations and a small uncontrolled series of 26 patients, the maneuver was rapidly adopted and became closely associated with Rapid Sequence Induction (RSI). More than six decades later, however, its place in contemporary AM remains unsettled.

The controversy cannot be reduced to a simple question of whether CP “works.” Birenbaum *et al.* conducted a large Randomized Controlled Trial (RCTs) involving 3,472 adults undergoing RSI, in which sham pressure was not shown to be non-inferior to CP for the prevention of PA.³ Nevertheless, aspiration occurred at similarly low rates in both groups, while several secondary findings suggested that intubation may have been more difficult when Sellick Maneuver (SM) was applied. In a subsequent large-scale systematic review and meta-analysis including 4,862 patients, no significant reduction in the risk of PA was observed. Furthermore, CP was associated with less favorable laryngoscopic views, prolonged intubation times, and lower first-attempt intubation success rates.⁴

Importantly, most participants in these studies were not at particularly high risk of aspiration, leaving uncertainty about whether selected high-risk populations might still benefit. The way in which the maneuver is performed adds another layer to the debate. CP is unlikely to achieve its intended purpose if the wrong anatomical structure is compressed, the applied force is inappropriate, or pressure is not released when it interferes with ventilation or intubation. Conventional surface-landmark identification of the Cricoid Cartilage (CC) has been shown to be unreliable,⁵ and many Healthcare Professionals (HPs) are unable to apply the recommended force without prior training. Simulation-Based Training (SBT) with Objective Force Feedback (OFF) can improve technical performance, although the acquired skill may deteriorate within weeks and its effect on clinical outcomes remains unknown.⁶ Our objective was to review the contemporary evidence regarding the rationale, effectiveness, safety, performance, and SBT of SM and to propose a Competency-Based Curriculum (CBC).

Materials and Methods

Review design

This study was designed as a structured narrative review and was prepared according to the Scale for the Assessment of Narrative Review Articles (SANRA), particularly its recommendations regarding the description of the literature search, appropriate referencing, and balanced presentation of the evidence.⁷

Literature search strategy

A comprehensive and a systematic literature search was conducted in major electronic databases, including PubMed/MEDLINE, Scopus, Web of Science, covering all available records up to July 2026. The search strategy involved relevant Medical Subject Headings (MeSH) terms and tailored keywords specific to ramp lesions and their associated treatments. The specific terms utilized included combinations of: “cricoid pressure,” “Sellick maneuver,” and “Sellick manoeuvre” with terms related to “rapid sequence induction,” “rapid sequence intubation,” “pulmonary aspiration,” “regurgitation,” “airway management,” “anatomy,” “safety,” “complications,” “simulation,” “education,” “training,” “competency,” and “skill retention.”

Eligibility criteria

Inclusion criteria prioritized RCTs, systematic reviews, meta-analyses, observational studies, anatomical and imaging investigations, clinical practice guidelines, consensus statements, SBT studies, and surveys evaluating the application, effectiveness, and educational aspects of CP. Historical reports, selected case reports, narrative reviews, and editorials were included when they provided important context regarding the evolution of the technique or helped identify additional relevant primary literature. English-language publications were prioritized. Publications were excluded if they were unrelated to SM or AM, lacked original scientific or educational content, represented duplicate reports, or contained insufficient methodological information to support meaningful interpretation. Conference abstracts without full-text articles and non-peer-reviewed publications were considered only when they contributed unique historical or contextual information.

Study selection

Titles were screened for relevance by one author (Z.S.). The abstracts and full texts were reviewed independently by two authors (P.P. and J.P.) to extract information on the above-mentioned topics. A total of 1,286 records were identified through electronic database searches. After removal of 312 duplicates, 974 records underwent title and abstract screening. Following eligibility assessment, 84 full-text articles were reviewed, of which 32 were excluded for predefined reasons. Fifty-two relevant studies were identified through database searching, and an additional 11 studies were retrieved from gray literature and manual reference searches, resulting in 63 publications included in the narrative synthesis.

Results

Historical rationale

CP entered clinical practice following Sellick's 1961 report. Because the CC forms a complete ring, posterior pressure was thought to compress the upper alimentary tract against the cervical vertebral body and prevent regurgitated contents from reaching the pharynx. Sellick *et al.* supported this concept with cadaveric observations and an uncontrolled series of 26 high-risk patients, in three of whom gastric or oesophageal contents appeared after the pressure was released.² However, neither the applied force nor the degree of luminal occlusion was measured objectively. Subsequent imaging studies questioned this anatomical explanation. In a computed tomography study of 51 adults, the oesophagus was laterally displaced relative to the CC in 49% of cases.⁸ Magnetic Resonance Imaging (MRI) subsequently demonstrated lateral displacement in 52.6% of volunteers before SM and 90.5% during its application, accompanied by lateral laryngeal displacement and varying degrees of airway compression.⁹

These findings challenged the assumption that the oesophagus lies directly between the CC and the vertebral column. The clinical significance of this displacement remains disputed. Rice *et al.* proposed that CP compresses the postcricoid hypopharynx rather than the cervical oesophagus.¹⁰ The authors demonstrated that the hypopharynx and CC moved together as an anatomical unit and that CP reduced the anteroposterior hypopharyngeal diameter by approximately 35%, even during lateral displacement. Modern anatomical evidence has therefore revised rather than disproved Sellick's rationale. However, anatomical compression demonstrated by imaging does not establish that CP prevents PA clinically.

Clinical effectiveness

Despite its physiological appeal and long-standing use, the clinical effectiveness of SM remains uncertain. Anatomical compression does not necessarily establish that the manoeuvre reduces regurgitation or PA during RSI. Demonstrating such an effect is challenging because aspiration is uncommon, definitions vary between studies, and adequately powered RCTs require large samples. PA occurred in 10 patients receiving SM and nine receiving the sham procedure, corresponding to incidences of 0.6% and 0.5%, respectively. No significant differences were observed in aspiration pneumonia, mortality, intensive care admission, or length of hospital stay. Because the prespecified non-inferiority margin was not met, the trial did not establish that omission of CP was non-inferior. Nevertheless, the nearly identical event rates provided no evidence of a clinically meaningful

protective effect. The lower-than-anticipated incidence of aspiration further limited statistical precision.³

White *et al.* evaluated PA, in only four studies and found that CP did not reduce the risk of aspiration compared with sham or no CP (RR 1.18; 95% CI 0.71–1.96).⁴ The authors also reported that CP was associated with a lower first-attempt intubation success rate, prolonged intubation time, and poorer laryngoscopic views. However, most study participants were non-obstetric adults at relatively low aspiration risk, and only three trials specifically enrolled high-risk patients. Current evidence therefore neither confirms that SM prevents aspiration nor conclusively excludes a benefit in selected high-risk patients. Its effectiveness is best described as unproven rather than disproven.^{3,4} Any potential benefit must consequently be weighed against possible interference with AM.

Safety and complications

The safety of CP depends heavily on its anatomical location, direction, and applied force. When correctly performed, serious complications appear uncommon. Excessive or misdirected pressure, however, may distort the larynx, obstruct airflow, and interfere with AM. The effect on mask ventilation is strongly related to both force and direction. Hartsilver *et al.* demonstrated that airway obstruction occurred in only 2% of 52 patients with a correctly applied 30 N posterior cricoid force. In contrast, airway obstruction increased to 35% with a 44 N posterior force and to 56% when a 30 N force was directed upward and posteriorly, highlighting the importance of both the magnitude and direction of applied force.¹¹ SM may also alter the laryngoscopic view. Haslam *et al.* reported substantial interindividual variation, with complete loss of glottic visibility in three patients at forces between 30 and 60 N.¹² These effects may persist with videolaryngoscopy. In a 2026 RCT involving 100 patients intubated using a C-MAC videolaryngoscope, CP prolonged mean intubation time by approximately four seconds, although the number of attempts and glottic view did not differ significantly.¹³ The manoeuvre may be particularly problematic when a Supraglottic Airway (SA) is required. Won *et al.* reported successful i-gel insertion in 71% of patients under SM compared with 95% under paratracheal pressure, while insertion was also slower and more difficult.¹⁴ Direct tissue injury is rarely reported but may be severe. Case reports describe oesophageal rupture during active vomiting against applied CP and CC fracture in a patient with previous laryngeal trauma.^{15,16} Although such reports cannot establish incidence, they illustrate the potential risks of maintaining pressure during forceful vomiting or applying it in suspected laryngeal injury. The principal safety concern is therefore not only direct trauma but also interference with oxygenation and airway

protection. If CP impairs mask ventilation, worsens laryngoscopy, prevents tube advancement, or obstructs rescue-Airway Placement (AP), it should be reduced or released without delay.

Current guidelines

Contemporary guidelines increasingly frame SM as a selective rather than obligatory component of RSI. Recently published guidelines from the Difficult Airway Society (DAS) recommend considering CP in patients at particularly high risk of PA, while acknowledging that the current evidence supporting its effectiveness remains limited.¹⁷ CP should be applied by a trained assistant at the correct anatomical location and force and reduced or released if it impairs ventilation, laryngoscopy, tracheal tube advancement, or supraglottic AP. Recommendations remain more supportive in obstetric anaesthesia, where the consequences of regurgitation and rapid hypoxaemia may be particularly severe. The Obstetric Anaesthetists' Association and DAS guidelines recommend approximately 10 N while the patient is conscious, increasing to 30 N after loss of consciousness.¹⁸ However, they emphasise prompt reduction or release during difficult ventilation or intubation and temporary removal during Supraglottic Airway Insertion (SAI). The 2026 Association of Anaesthetists guideline does not mandate CP during prehospital emergency anaesthesia because of its uncertain benefit and potential to worsen intubating conditions.¹⁹ Although, during cardiac arrest, the current guidelines recommend against its use because it may interfere with ventilation and advanced- AP without established benefit.²⁰ Zdravkovic *et al.* included more than 10,000 anaesthetists and 16 airway experts, found that approximately 70% preferred the SM during RSI for intestinal obstruction, compared with 50% during RSI without obstruction, with substantial geographical variation.²¹

Sajayan *et al.* found that 92% used the manoeuvre, although 83% never measured the applied force objectively.²² The principal evidence and recommendations are summarized in Table 1. Despite variation between guidelines, a consistent principle has emerged: oxygenation and successful AM take priority, and CP should be reduced or released whenever it becomes obstructive.

Special populations

The balance between the potential benefits and harms of CP varies across patient populations and clinical settings. Its use should therefore reflect aspiration risk, physiological reserve, airway anatomy, anticipated Airway Difficulty (AD), and the availability of trained personnel. Obstetric patients remain among the populations in whom CP is most firmly embedded in practice. Pregnancy-related physiological changes may increase the consequences of regurgitation, while reduced functional residual capacity predisposes to rapid oxygen desaturation. Current guidance supports SM during obstetric RSI but emphasises correct force and prompt release if ventilation or intubation becomes difficult.¹⁸ The manoeuvre should form part of a broader strategy incorporating head-up positioning, effective preoxygenation, gentle mask ventilation when required, and early use of a second-generation SA after failed intubation. Adult force targets should not be extrapolated directly to children. Walker *et al.* reported that the mean force required to produce at least 50% subglottic airway compression or distortion was 10.5 N, while lower forces such as 5 N resulted in substantial airway compression in infants younger than one year.²³

The protective effectiveness of CP in children remains unproven, and validated age-specific force targets are lacking. If used, particular caution is required, with immediate release if airway compromise occurs. Critically ill, emergency, and pre-hospital patients may have increased aspiration risk because of inadequate fasting, intestinal obstruction, impaired consciousness, delayed gastric emptying, or gastrointestinal pathology. However, they frequently have limited oxygen reserve and may deteriorate rapidly during prolonged or repeated intubation attempts. Contemporary guidance therefore supports selective rather than automatic application, with oxygenation and first-attempt success taking priority.^{17,19} SM is not recommended during cardiac arrest and should be avoided or used cautiously in suspected laryngeal or anterior neck injury.^{16,20} Overall, classification as “high risk” should not determine practice automatically; decisions should be individualized and supported by a team capable of applying and releasing the manoeuvre appropriately.

Performance gap

The controversy surrounding CP is not limited to whether the manoeuvre is clinically effective. Even if it can provide a protective barrier when performed correctly, its real-world value depends on accurate anatomical localization, application of an appropriate and sustained force, correct timing, and immediate adjustment when AM becomes difficult. Evidence suggests that these conditions are frequently not achieved in routine practice. Palpation alone may fail to identify the CC accurately, while several RCT's have shown considerable variation in clinicians' knowledge of the recommended

force and in how that force is applied.^{5,22} Objective measurement is rarely available, leaving operators to rely on subjective tactile judgement. Furthermore, SM is sometimes confused with external laryngeal manipulation or the Backward, Upward, Rightward Pressure (BURP) manoeuvre, which have different purposes and directions of force.²⁴ These errors may occur simultaneously and become more consequential during a time-critical or difficult intubation. The principal components of this performance gap—anatomical localization, force application, timing and release, and differentiation from BURP—are considered below.

Incorrect anatomical localization

Correct localization of the CC is often assumed to be straightforward, yet surface palpation is unreliable even when performed by experienced practitioners. The cartilage must be distinguished from the Thyroid Cartilage (TC), cricothyroid membrane, and upper tracheal rings. In a multicentre study of 100 adults, conventional palpation identified the midpoint of the CC with an error greater than 5 mm in 41% of patients and greater than 10 mm in 21%. Accuracy was not associated with practitioner experience, patient age, sex, or body mass index.^{5,22} Similarly, Williams *et al.* reported a median distance of 10 mm between the location identified by physical examination and that confirmed by ultrasound.²⁵ These errors are clinically relevant because the anterior arch of the CC is relatively small. Pressure applied too cranially may act on the TC or cricothyroid membrane and distort the larynx, whereas pressure applied too caudally may compress the trachea without adequately occluding the postcricoid hypopharynx.

Ultrasound can identify the CC more reliably and may provide useful feedback during training or permit pre-induction marking in selected patients.⁵ However, its routine use during time-critical AM remains impractical and has not been shown to reduce aspiration. Reliable palpation supported by objective anatomical training therefore remains an essential component of competency.

Incorrect force application

Correct force application is difficult because the operator receives no objective indication of how much force is transmitted to the CC. Contemporary guidance generally recommends approximately 10 N while the patient is conscious, increasing to 30 N after loss of consciousness.^{17,18} Forces below the target may provide inadequate compression, whereas excessive force may distort the larynx, impair ventilation, or worsen intubating conditions.

The direction of force is equally important. In a study investigating knowledge of the CP technique among 135 anaesthetic assistants attending the annual conference of the British Association of Operating Department Assistants, only one-third of the participants identified the recommended force for CP application, and fewer than half were able to cite even a single contraindication to its use.²⁶ SBT was uncommon before clinical practice, and baseline performance showed substantial variability in applied force. Both structured instruction and simulator-based practice significantly improved the accuracy and consistency of force application within the recommended range (30–44 N). Andruszkiewicz *et al.* reported that only 16.5% applied the recommended force correctly on the first attempt and 20.4% on the second attempt.²⁷ The median forces applied were 36 N and 38 N, respectively, with wide interquartile ranges extending up to 55 N, indicating substantial variability in force application. Furthermore, the authors observed considerable interindividual variability among HPs, highlighting the difficulty of consistently applying the recommended cricoid pressure force in clinical practice.

SM is therefore not a binary manoeuvre but a force-dependent technical skill. Verbal instructions such as “apply firm pressure” are insufficient; training requires Force Feedback (FF), repeated practice, and periodic reassessment.

Timing and release errors

The timing of CP determines whether it is potentially protective or harmful. Applying full force before loss of consciousness may cause discomfort, coughing, retching, or airway obstruction, whereas delayed application may leave an interval during which protective airway reflexes are diminishing. Current guidance therefore recommends applying approximately 10 N before loss of consciousness and increasing the force to 30 N once the patient becomes unconscious.^{17,18} CP should normally be maintained until the tracheal tube cuff has been inflated and correct tube position has been confirmed. Premature release may remove the intended barrier during a particularly vulnerable stage of AM. The opposite error is to maintain CP despite evidence that it is interfering with oxygenation or airway instrumentation. If mask ventilation, laryngoscopy, or tracheal tube advancement becomes difficult, the force should be reduced, adjusted, or released. Temporary release is also recommended when SM impedes insertion of a SA device. If active vomiting occurs, pressure should be released immediately and the pharynx suctioned, because maintaining compression during forceful vomiting may contribute to oesophageal rupture.¹⁴

Thwaites *et al.* conducted a questionnaire survey among 210 obstetric anaesthetists and found substantial variation in the timing of SM application.²⁸ Furthermore, 22.5% of respondents reported that they would not release the SM during difficult tracheal intubation. Maintaining the recommended force throughout the CP may also be challenging. Meek *et al.* reported that only one of six trained assistants was able to sustain the recommended force of 30 N throughout a 20-minute period.²⁹

CP versus BURP

Both CP and the BURP are sometimes treated as interchangeable forms of external neck pressure, although their anatomical targets, directions, and clinical purposes differ.²⁴ CP is applied to the CC in a posterior direction and is intended to compress the postcricoid hypopharynx during induction. BURP is applied to the TC to improve visualization of the glottis during difficult laryngoscopy and has no established role in preventing regurgitation. Snider *et al.* applied a modified BURP manoeuvre to the CC in 43 patients and observed that it worsened the laryngoscopic view in 30% of cases, compared with 12.5% during conventional CP.³⁰ Confusing both manoeuvres may result in pressure being applied to the incorrect anatomical structure or in an inappropriate direction. Upward and rightward displacement of the CC does not constitute correctly performed SM and may distort the larynx. Conversely, posterior pressure on the TC should not be assumed to provide protection against aspiration. Clear terminology and communication are therefore essential. If CP worsens the view, it should be adjusted or released and, when appropriate, replaced by external laryngeal manipulation directed by the laryngoscopist.¹⁷ Simulation should require learners to identify the correct cartilage, describe the purpose and direction of each SM, and respond appropriately to AD. These distinctions and the principal performance errors are summarized in Figure 1.

Simulation-Based Training for CP

The performance gaps described above make CP particularly suitable for SBT. Correct performance depends on a combination of anatomical knowledge, tactile discrimination, force control, appropriate timing, and communication with the clinician managing the airway.

These components cannot be adequately assessed through verbal questioning or observation of the manoeuvre alone. Furthermore, clinical exposure is unpredictable, and practising an incompletely mastered technique during a time-critical induction may introduce avoidable risk. Simulation allows the manoeuvre to be repeatedly performed in a controlled environment while providing OFF on hand

position, direction and magnitude of force, and the response to AD. Previous studies using simulation task trainers have demonstrated that HPs frequently apply incorrect cricoid pressure forces at baseline, and that technical performance improves significantly following structured SBT.^{26,27} More broadly, technology-enhanced simulation has been associated with improved knowledge and clinical skills compared with no educational intervention, although evidence demonstrating direct improvements in patient outcomes remains limited.⁶ Importantly, simulation should not merely teach the routine application of CP. It should also develop clinical judgement regarding when the manoeuvre is appropriate, when it should be modified or released, and how it interacts with ventilation, laryngoscopy, and rescue airway techniques. The available educational approaches and supporting evidence are considered below.

Didactic education

Didactic education remains necessary for explaining the rationale, indications, contraindications, and recommended force of CP, but it cannot independently develop the required psychomotor skill. Numerical force targets do not provide the tactile reference required for reproducible clinical performance, and qualitative descriptions such as “firm” or “moderate” pressure are interpreted inconsistently. Owen *et al.* reported that only 5 (10%) of 50 trained HPs applied CP correctly; after structured practice on an anatomically realistic task trainer, 45 (90%) achieved correct technical performance.³¹ Escott *et al.* likewise showed that verbal descriptions alone did not enable reliable force maintenance.³² Didactic teaching should therefore establish the conceptual foundation, while practical training provides measured force calibration and scenario-based application.

Available simulation modalities

Simulation modalities for CP range from inexpensive force-calibration tools to full-scale airway scenarios. Weighing scales and sealed 50-mL syringes provide a simple tactile reference and can improve short-term force accuracy, but do not assess anatomical localization, direction, timing, or performance in context.³³ Sensor-enabled part-task trainers can measure the location, direction, magnitude, and duration of CP and provide real-time feedback.^{31,34} Ultrasound may provide an anatomical training, whereas full-scale manikin scenarios permit assessment of timing, communication, situational awareness, and appropriate adjustment or release during airway difficulty.^{5,25} A progressive combination of force calibration, sensor-enabled deliberate practice, and team-based scenarios therefore offers a practical framework for comprehensive training (Table 2).

Effectiveness of SBT

Available evidence consistently supports the effectiveness of simulation for improving the immediate technical performance of CP. In the systematic review by Johnson *et al.*, including 12 studies with 772 participants, only 23% of HPs achieved the predefined performance target before training, highlighting a substantial gap in technical competency.⁶ Moreover, the meta-analysis of 10 studies of the above-mentioned systematic review involving 570 participants demonstrated that SBT significantly improved performance compared with no intervention (pooled effect size 1.18; 95% CI 0.85–1.51; $P < 0.0001$), supporting its effectiveness. Training incorporating OFF was more effective than practice without feedback.⁶ Individual studies have reported similarly substantial improvements in the accuracy of anatomical localization and force application.^{31,34}

Evidence that simulator-acquired skills transfer to clinical performance is more limited but encouraging. Domuracki *et al.* randomized 101 HPs to simulator training with or without force feedback before clinical application of CP; an appropriate mean force was achieved by 38% in the feedback group versus 19% in the control group ($p = 0.035$).³⁵ Similarly Beckford *et al.* concluded that educational interventions improve CP performance.³⁶ However, most studies assessed immediate simulator performance, often on the same device used for training, and few evaluated localization, timing, release, communication, or performance during airway difficulty. Evidence that these educational gains improve patient-centred outcomes remains insufficient.

Knowledge and skill retention

Immediate improvement after simulation should not be equated with durable competency. Available studies suggest relatively rapid skill decay.³³ Training with a 50-mL syringe produced significant immediate improvement that remained detectable after one week but was no longer maintained after one month. Ashurst *et al.* found that 72% of 18 HPs reassessed 14–21 days after training retained the ability to apply an appropriate force, although force still declined during sustained application.³⁷ These findings support performance-based reassessment and brief booster training; however, the evidence is insufficient to define a universal retraining interval.

Proposed CBC

Training in CP should be competency-based rather than defined by attendance at a lecture or completion of a fixed number of practice attempts. We propose a six-stage curriculum based on mastery-learning principles, in which learners continue practising until a predefined performance standard is achieved. The curriculum should include anaesthesiologists, trainees, anaesthetic nurses, anaesthesia assistants, operating-department practitioners, and emergency or intensive-care personnel who may be expected to apply the manoeuvre. The curriculum should include anaesthesiologists, trainees, anaesthetic nurses, anaesthesia assistants, operating department practitioners, and emergency or intensive care personnel who may be expected to apply the manoeuvre.

The first stage consists of structured pre-course learning covering the anatomical rationale, clinical controversy, indications, potential complications, recommended adult forces, and criteria for adjustment or release. The second stage is an unassisted baseline assessment performed without real-time visual feedback. It evaluates anatomical localization, hand position, direction, initial force, and the ability to maintain force, thereby identifying individual learning needs and providing an objective reference for subsequent improvement. During the third stage, learners undertake deliberate part-task practice using a sensor-enabled trainer. They should practise applying approximately 10 N before loss of consciousness and 30 N afterwards, maintaining a stable force, and switching between targets in response to verbal commands.^{17,18} Ultrasound or an anatomically representative model may be used to correct localization errors.^{5,25} Feedback should initially be continuous and subsequently withdrawn to assess independent performance. The fourth stage integrates the skill into full-scale scenarios, including uncomplicated RSI, difficult mask ventilation, poor laryngoscopic visualization, failed intubation, SAI, and active vomiting. Learners must demonstrate closed-loop communication and distinguish CP from BURP and other forms of external laryngeal manipulation. The fifth stage is competency assessment without real-time visual feedback. Proposed provisional criteria include correct landmark identification, posterior force application, maintenance within a predefined tolerance around the adult target for at least 80% of the assessed period, and an appropriate response to every safety-related criteria. These thresholds are illustrative and require prospective validation before adoption as high-stakes standards. The sixth stage addresses retention and skill decay. Performance should initially be reassessed approximately four weeks after training, followed by brief booster sessions and periodic reassessment.^{6,33,37} Subsequent intervals should reflect demonstrated performance, clinical exposure, and local resources rather than attendance alone. The proposed pathway is summarized in Figure 2.

Bulgarian perspective

SBT is expanding in Bulgaria, although its implementation remains heterogeneous across institutions and clinical disciplines. The Medical Simulation Training Centre at the Medical University of Plovdiv (MU-Plovdiv),³⁸ represents an important national educational resource. In 2019, the Centre received Accredited Education Institute status from the American College of Surgeons, becoming the sixth such centre in Europe.³⁹ Its infrastructure includes task trainers, high-fidelity manikins, and virtual-reality platforms supporting undergraduate, postgraduate, and continuing medical education (ME). Sakakushev *et al.* highlighted the broader role of SBT in strengthening ME and supporting the development of clinical competencies in Bulgaria.⁴⁰ To our knowledge, CP has not yet been incorporated as a dedicated, standardized, competency-based component (CBC) of the undergraduate anaesthesiology curriculum, either at MU-Plovdiv, as well as across all the medical MU's in Bulgaria. This local observation provides a rationale for piloting and prospectively evaluating a structured CP training pathway rather than implying a national deficiency.

Discussion

The central finding of this narrative review is that uncertainty about the clinical effectiveness of CP coexists with a well-documented performance problem. This distinction is important: the absence of conclusive evidence that CP prevents aspiration does not justify assuming that technique is irrelevant when the manoeuvre is selected, while technical proficiency alone cannot establish clinical benefit. Contemporary guidance therefore supports a context-dependent approach in which aspiration risk, anticipated AD, physiological reserve, and operator competence are considered together. The educational implication is equally important: training should focus not only on reproducing a target force, but also on clinical judgement, communication, and timely modification of the manoeuvre. This reframes CP from a routine procedural step into a conditional airway intervention whose potential value depends on appropriate patient selection and competent execution

Clinical implications

The decision to use CP should be individualized rather than determined solely by tradition or broad risk-group membership. Clinicians should consider aspiration risk, anticipated AD, physiological reserve, planned airway technique, and the availability of a trained assistant. When CP is selected in

adults, the assistant should identify the cricoid cartilage before induction and apply approximately 10 N while the patient is conscious, increasing to 30 N after loss of consciousness.^{17,18} Adult force targets should not be extrapolated directly to children.²³ CP should normally be maintained until the tracheal tube cuff is inflated and correct tube position is confirmed.

Oxygenation and successful airway management take priority over continued CP. Pressure should be adjusted or released if it impairs ventilation, laryngoscopy, tube advancement, or supraglottic airway insertion, and active vomiting should prompt release and pharyngeal suction.^{16–20} CP should remain distinct from BURP or other external laryngeal manipulation. Institutions should incorporate these principles into standardized airway protocols and ensure that personnel expected to apply CP receive appropriate training.

Bulgarian implications

Within Bulgaria, the immediate priority is not to presume universal educational deficiency but to establish whether CP teaching and assessment are standardized across institutions. A national survey of medical universities and affiliated teaching hospitals could map current practice, followed by a prospectively evaluated pilot curriculum at centres with established simulation infrastructure. Relevant outcomes should include localization accuracy, force–time performance, appropriate responses to safety-critical events, retention, feasibility, and acceptability.

These data could support consensus recommendations developed collaboratively by anaesthesiology and intensive-care departments, simulation centres, nursing educators, and professional societies. Such an implementation strategy would use simulation primarily to standardize demonstrable competence while simultaneously generating evidence on feasibility, retention, and transfer to clinical practice. Whether improved training ultimately reduces airway complications or improves patient outcomes remains a separate question requiring prospective multicentre evaluation.

Strengths and Limitations

The present review has several strengths that should be acknowledged. A comprehensive search across multiple electronic databases enabled broad coverage of anatomical, clinical, guideline, and educational evidence. Its multidisciplinary perspective integrates anaesthesiology, emergency medicine, surgery, critical care, and ME. A further strength is the translation of this evidence into a

structured six-stage curriculum that can be prospectively tested rather than presented as an established standard.

From the other side as a narrative rather than systematic review, the study is inherently more susceptible to selection bias. No quantitative synthesis, formal risk-of-bias assessment, or methodological quality grading of included studies was performed. The educational literature is heterogeneous in study design, participants, interventions, outcome measures, and simulation protocols, and long-term retention and clinical transfer have been evaluated inconsistently. Accordingly, the proposed curriculum and competency thresholds should be regarded as a testable framework requiring prospective validation.

Future directions and recommendations

Future research should address two linked but distinct questions: which patients, if any, derive a clinically meaningful net benefit from CP during contemporary RSI, and how competence should be defined when CP is used. Clinical studies should prioritize adequately characterized high-risk populations and patient-centred outcomes. Educational studies should validate objective performance standards, compare retraining intervals, assess transfer beyond the training device, and evaluate implementation across different professional groups and resource settings. In Bulgaria, multicentre mapping of current training practices followed by prospective evaluation of a standardized curriculum would provide a rational sequence for national implementation.

Conclusions

CP remains a debated component of contemporary airway management, with uncertain effectiveness for preventing pulmonary aspiration and substantial variability in clinical performance. When CP is selected, safe use depends on correct localization, appropriate force, clinical judgement, and prompt adjustment when airway management is impaired. Simulation-based, competency-oriented training provides a rational approach to standardizing these skills, but the proposed curriculum and its impact on clinical outcomes require prospective validation

List of acronyms

AC, airway complications
AD, airway difficulty
AI, airway insertion
AP, airway placement
BURP, backward, upward, rightward pressure
CBC, competency-based curriculum
CC, cricoid cartilage
CP, cricoid pressure
DAS, Difficult Airway Society
HPs, healthcare professionals
ME, medical education
MRI, magnetic resonance imaging
MU, Medical University of Plovdiv
PA, pulmonary aspiration
RCTs, randomized controlled trial
RSI, rapid sequence induction
RTVFB, real-time visual feedback
SAI, supraglottic airway insertion
SANRA, Scale for the Assessment of Narrative Review Articles
SA, supraglottic airway
SBT, simulation-based training
SCC, safety-related criteria
SM, Sellick maneuver
TC, thyroid cartilage

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Zlatina Stoyanova, Plamen Penchev, and Jannis Papathanasiou; Writing – Review & Editing, Zlatina Stoyanova, Petya Trendafilova, Hristo Bozov, Plamen Penchev, and Jannis Papathanasiou. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no potential conflict of interest, and all authors confirm accuracy.

Ethics approval

The Ethics Committee of the University Multiprofile Hospital of Burgas, Bulgaria approved this study (Approval No. 15005/03.11.2025). The study is conformed with the Helsinki Declaration of 1964, as revised in 2013, concerning human and animal rights.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

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Table 1. Principal evidence and contemporary recommendations concerning Cricoid Pressure CP.

Source	Design or context	Principal finding or recommendation	Practical interpretation
Sellick, 1961 [2]	Preliminary clinical report	Regurgitation was observed after release of CP in three of 26 high-risk patients	Provided the historical rationale but not controlled evidence of effectiveness
Birenbaum et al., 2019 [3]	IRIS RCTs involved 3,472 patients	Aspiration occurred in 0.6% with CP and 0.5% with sham pressure; non-inferiority of sham was not established	Neither a protective benefit nor the equivalence of omission was demonstrated conclusively
White et al., 2020 [4]	Meta-analysis of 12 RCTs	No reduction in aspiration; poorer first-attempt success, longer intubation, and worse laryngoscopic views	Effectiveness remains unproven, with evidence of possible airway interference
DAS 2025 [17]	Adult difficult-airway guideline	Consider use in patients at particularly high aspiration risk;	Supports selective rather than routine application

		release if airway management is impaired	
OAA/DAS 2015 [18]	Obstetric difficult-airway guideline	Apply approximately 10 N while conscious and 30 N after loss of consciousness; reduce or release if difficulty occurs	More supportive in obstetric RSI, but oxygenation remains the priority
Association of Anaesthetists 2026 [19]	Prehospital emergency anaesthesia guideline	CP is not mandated; correct application and release during difficulty are advised	Use should depend on the clinical context and team competence
ERC 2025 [20]	Adult cardiac-arrest guideline	CP is not recommended during cardiac arrest	Potential interference outweighs an unproven benefit

Table 2. Comparison of available simulation modalities for Cricoid Pressure CP training.

Simulation modality	Skills assessed or trained	Feedback provided	Main advantages	Main limitations	Suggested educational use
Weighing scale or sealed 50-mL syringe	Approximate force calibration	Visual scale reading or tactile resistance	Inexpensive, portable, and suitable for frequent practice [33]	Does not assess anatomical localization, direction, timing, or release; force estimates may vary between devices	Initial familiarization and brief refresher training
Non-instrumented	Landmark identification, hand position,	Observation and	Widely available and easy to	Cannot objectively measure force	Introductory anatomical and

airway manikin	and general technique	instructor feedback	incorporate into airway teaching	or detect subtle directional errors	procedural training
Sensor-enabled part-task trainer	Localization, direction, magnitude, and duration of pressure	Real-time numerical, visual, or tactile feedback	Enables objective assessment, deliberate practice, and predefined competency thresholds [31,34]	Greater cost and limited availability; clinical transfer remains insufficiently studied	Core technical-skills training and competency assessment
Ultrasound-assisted landmarking	Identification of the CC and recognition of anatomical variation	Direct visualization of the palpated landmark	Demonstrates localization errors and improves anatomical understanding [5,25]	Requires ultrasound equipment and operator expertise; does not assess force, timing, or communication	Anatomical teaching and targeted remediation
Full-scale manikin scenario	Timing, communication, maintenance, adjustment, and release during airway difficulty	Instructor observation, video review, and structured debriefing	Recreates rapid sequence induction and integrates technical and non-technical skills	Resource-intensive; force cannot be quantified unless the manikin is sensor-enabled	Team-based training and assessment of clinical decision-making
Blended simulation curriculum	Complete sequence from localization and force	Combined quantitative feedback	Integrates technical accuracy, clinical	Requires faculty training, equipment,	Competency-based initial training and

	calibration to team performance	and scenario debriefing	judgement, and teamwork	protected time, and curriculum coordination	periodic reassessment
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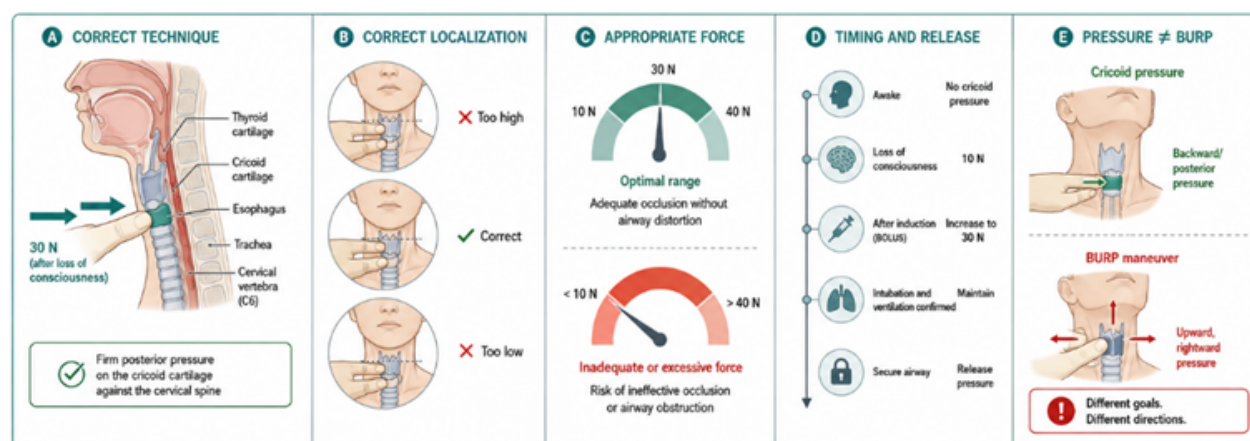


Figure 1. Key determinants and safe Cricoid Pressure CP.



Figure 2. Proposed Competence-Based Curriculum CBC for Cricoid Pressure CP training incorporating mastery learning, objective assessment, and periodic reassessment.