

Learning Objectives

Upon completion of this activity, the participant will be able to:

- identify differences between cricoid and paratracheal pressure,
- recognize complications of cricoid pressure,
- assess pertinent anatomy on ultrasound imaging,
- evaluate benefits of paratracheal pressure to prevent aspiration
- formulate incorporation of paratracheal pressure into practice.

Background

Pulmonary aspiration

- Incidence rate is 0.3%, ↑ in high-acuity settings^{9,11}
- Rare but serious cause of perioperative adverse events^{16,20}

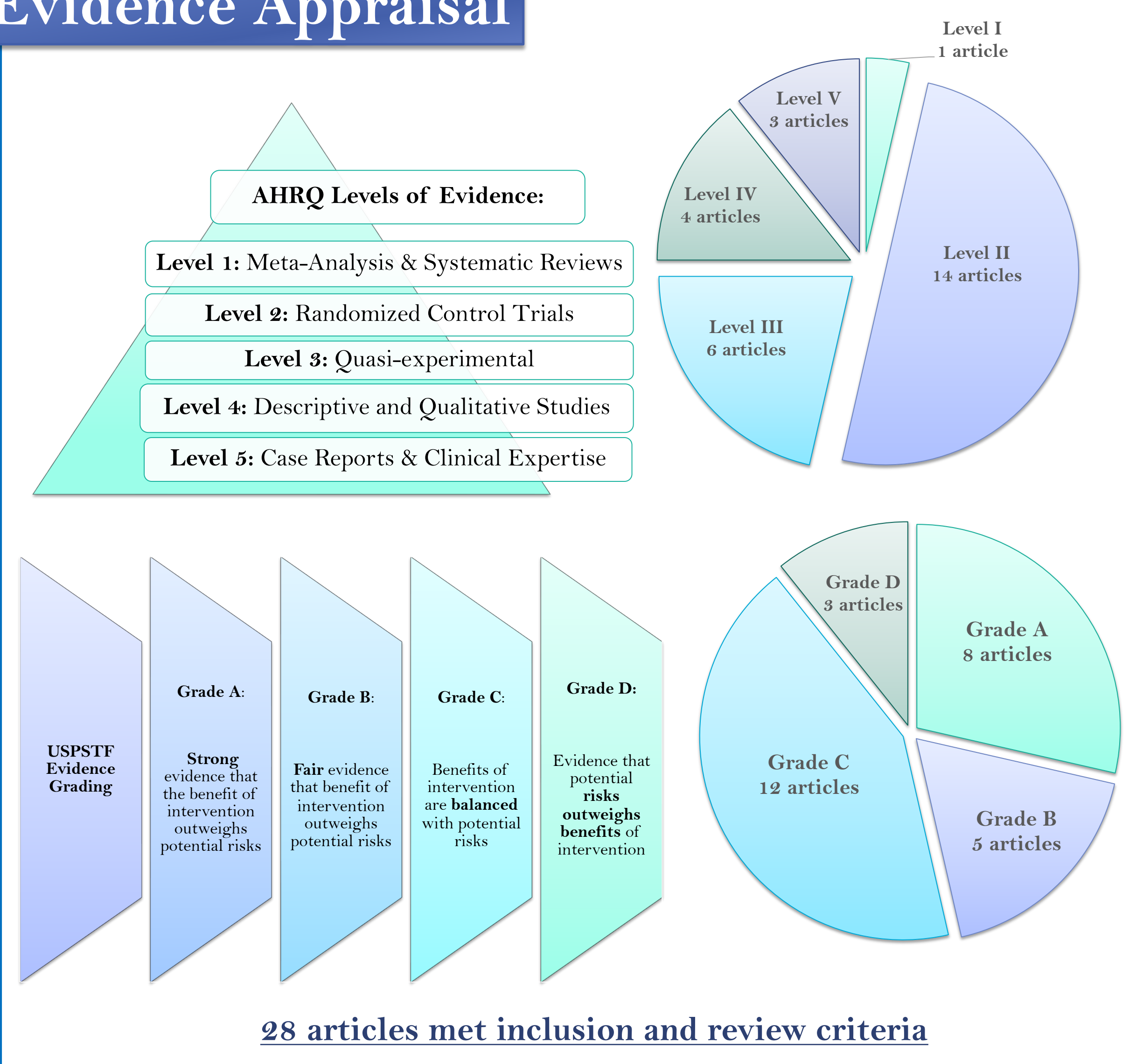
Cricoid Pressure

- Equivocal support in literature^{7,18}
- Inconsistent clinical application
- Aspiration events noted despite use of cricoid pressure⁷

Paratracheal Pressure

- Quantitative esophageal closure when US-guided¹¹
- Decreased gastric insufflation^{11,17}
- Less susceptible to external manipulation²⁶

Evidence Appraisal



Study Designs

Major Variables:

- Age, BMI, ASA status, Mallampati score, presence of full stomach, NPO Status
- Patients undergoing **general anesthesia with rapid sequence induction**
- Presence of a nasogastric tube before induction
- **Risk factors for aspiration:** Gastroparesis, GERD, Hernia, ileus, Diabetes Mellitus

Inclusion and exclusion criteria:

- **Inclusion:** Male or female patients 18-75 years of age, ASA I-III
- **Exclusion:** Obstetrics, pediatrics, **predicted difficult airway**, and emergency procedures

Esophageal Anatomic Variations & CP

MRI scans have demonstrated significant anatomical variation:^{7,24}

- 52.6% of patients have **lateral esophageal displacement** before CP²⁴
- Lateralization increased to 90.3% after CP ($p = .013$)⁷
- **Prevents esophageal closure against vertebral bodies**²⁴

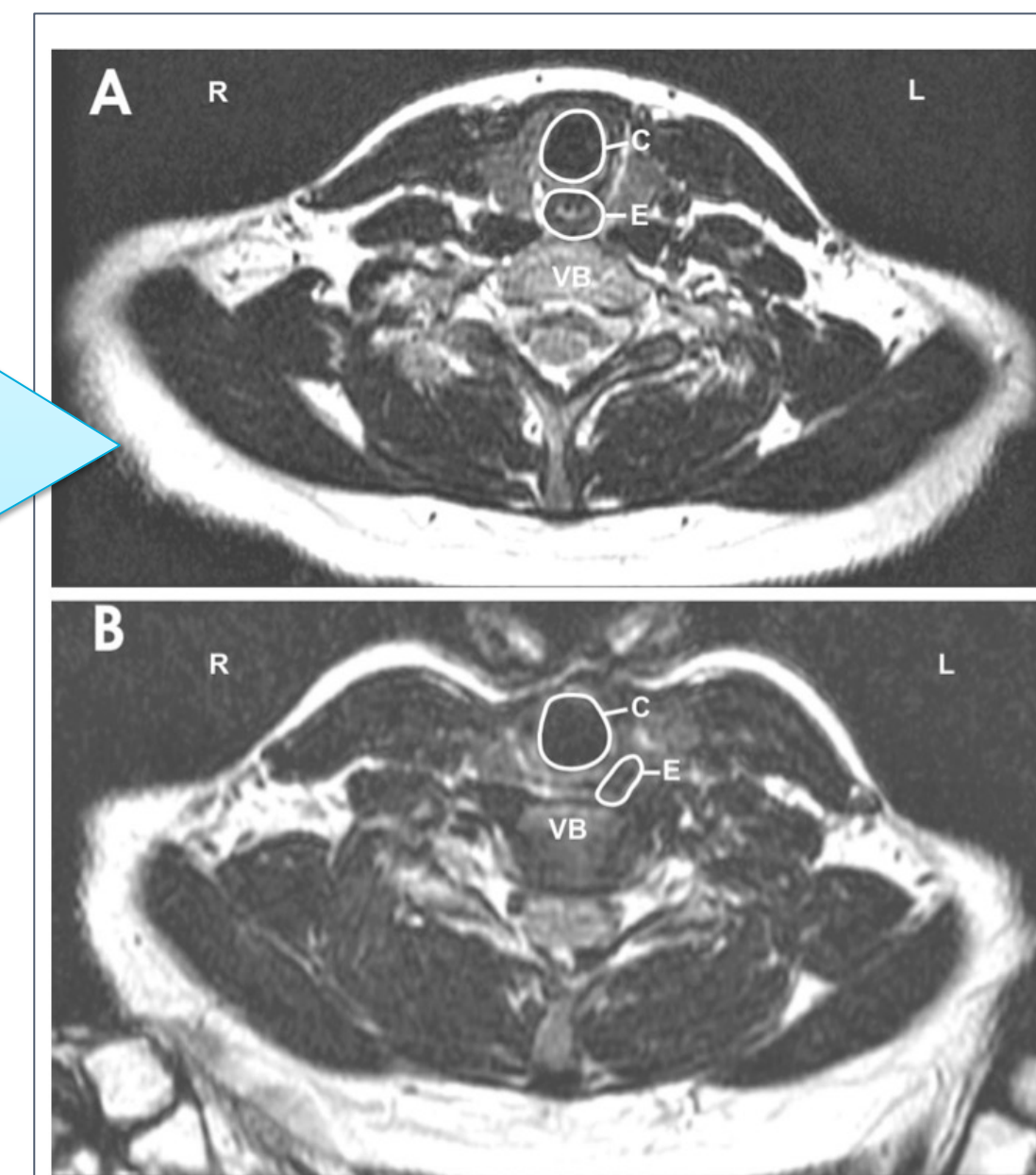


Fig. 3. (A) Magnetic resonance image of the neck without cricoid pressure. (B) Magnetic resonance image of the same subject demonstrating 12.1 mm of lateral esophageal displacement to the left with application of cricoid pressure. C = cricoid cartilage, E = esophagus, VB = vertebral body.

CP ineffective in 50% of patients if esophagus is left of midline.⁷

Complications of Cricoid Pressure

Misidentification leads to incorrect application^{8,16,29}

- 30.2% of nurse anesthesia students had formal training ($p < .001$)²⁹
- Knowledge gap from lack of formalized training^{16,29}
- Cricoid cartilage fracture & esophageal rupture from excessive force^{8,16,20,29}

How does cricoid pressure affect intubation?

- Higher Cormack-Lehane Grade during glottic visualization^{7,9,18}
- Increased time to intubation with decreased first-attempt success rate^{7,16,18,19,29}

Cricoid pressure decreases lower esophageal sphincter (LES) tone^{4,6}

- Decrease in LES proportionate to applied force^{4,21,25}
- Nullifies compensatory increase of LES tone from succinylcholine^{4,21,25}
- Return of LES tone occurs with removal of cricoid pressure²¹

Is it time for a “left shift”?

Complete esophageal closure:

- Force applied cephalad to the **left clavicle** with US probe¹¹
- Esophagus compressed directly **below cricoid level**¹⁵
- Quantitative assessment of esophageal closure with US^{11,15}

Effects on laryngoscopic view:

- Proper PTP does not compress hypopharyngeal space^{11,15}
- **Efficacy is less susceptible** to BURP maneuvers²⁶
- Expiratory V_T ↑↑ during mask ventilation ($p < .001$)^{17,23}

Gastric insufflation prevention:

- **Early air detection in esophagus and gastric antrum**¹⁷
- Real-time assessment allows modification of maneuver¹⁷
- Decreased gastric insufflation risk ($p < .001$; $p < .001$)^{11,17}

Paratracheal vs. Cricoid Pressure

Paratracheal Pressure

Successful airway insertion ↑↑^{7,14}
($p = 0.007$)

Rates of ‘difficult intubation’ ↓⁷

Gastric insufflation volume ↓¹¹
($p < 0.001$)

Easier mask ventilation ($p < .008$)²⁸

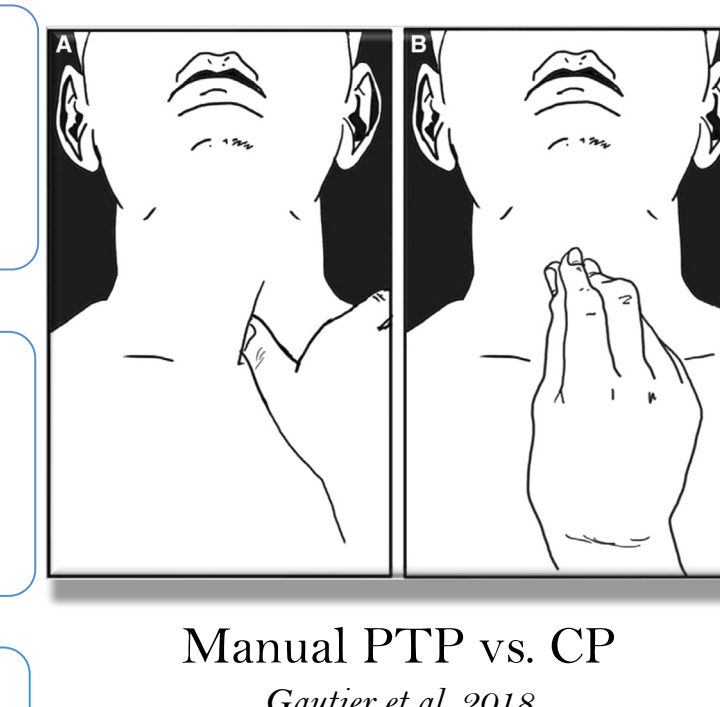
Cricoid Pressure

↓ percentage of glottic opening visible in DL²⁸

DL first-pass success rate ↓↓²⁸

Time to tracheal intubation ↑²⁸

Rate of airway obstruction ↑↑¹⁴
($p < 0.001$)



Manual PTP vs. CP
Gautier et al. 2018

US-Guided Paratracheal Pressure

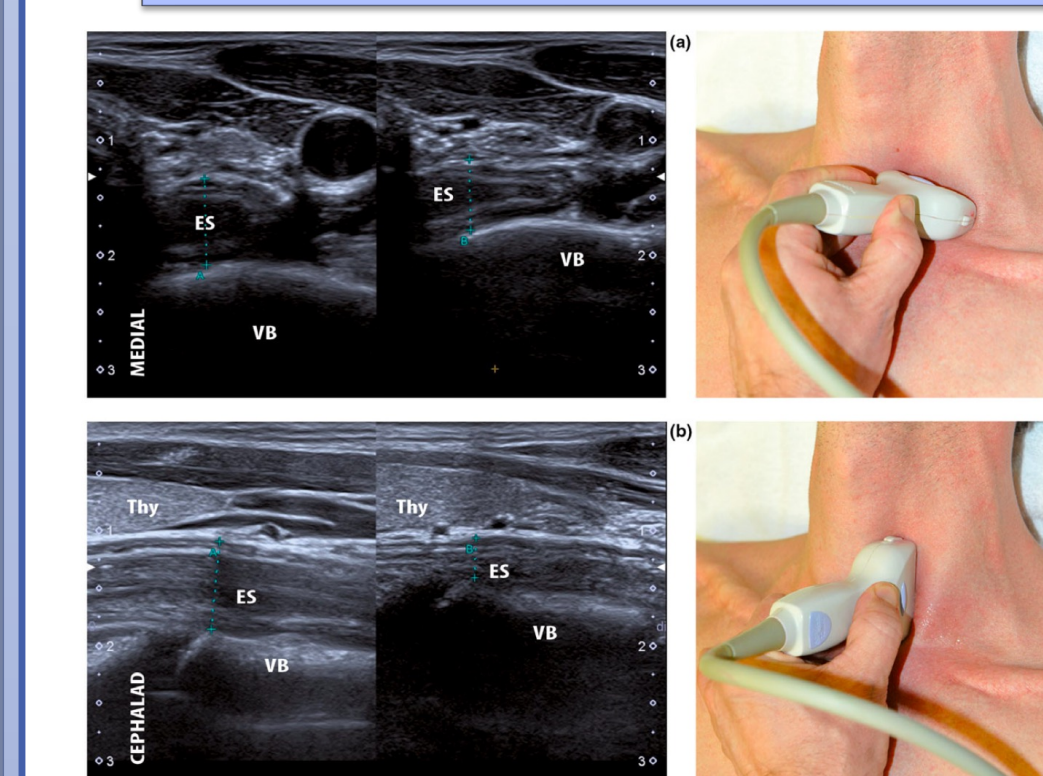
- Position:** Supine or Semi-fowlers
- Probe:** Linear 17-5 MHz or Hockey Stick Probe 15 -7 MHz¹¹
- Placement:** Left side of the neck; axial or sagittal plane
- Target:** Esophagus
- Landmarks:** Thyroid, vertebral body, Sternocleidomastoid, Cricoid Cartilage¹¹

Place probe at cricoid level on left neck

Identify the esophagus

Note: esophagus may be unidentifiable in 13% of patients at cricoid level¹

Scan caudad to follow natural lateralization of esophagus



Occluding the Esophagus:

Apply 30 N of force immediately cephalad to left clavicle

-AP diameter can be ↓ 40%¹¹
-AP diameter compression not affected by neck circumference or gender¹

Practice Recommendations

Use quantitative evaluation of esophageal closure

Utilize PTP if abnormal anterior neck anatomy

Opt for US-guided PTP in place of cricoid pressure

Apply adjunct interventions* when appropriate

*Adjuncts for Pulmonary Aspiration Prevention:

- Omit pre-curarization dose of NDNMB in RSI
- May prevent protective increase in LES tone with succinylcholine^{2,10}
- Utilize pre-operative gastric POCUS in high-risk individuals
- Full stomach if >1.5 ml/kg of fluid or solid in gastric antrum²⁷
- Pre-operative nasogastric tube placement
- Empty stomach and remove prior to induction^{10,12}

References

1. Achar & Shetty, 2022, 2. Ahlstrand et al., 2011, 3. Ajmal, 2018, 4. Algje et al., 2015, 5. Andruskiejcz et al., 2026, 6. Bham & Markham, 2019, 7. Birenbaum et al., 2019, 8. Butt & Hoda, 2019, 9. Dunn, 2022, 10. Fukano et al., 2011, 11. Gautier et al., 2018, 12. Hartsilver & Vanner, 2000, 13. He et al., 2022, 14. Hur et al., 2021, 15. Kim et al., 2022, 16. Kopka & Robinson, 2016, 17. Li et al., 2021, 18. Mittal et al., 2023, 19. Noll et al., 2019, 20. Parson & Duke, 2018, 21. Salem et al., 2008, 22. Salem et al., 2017, 23. Seol et al., 2023, 24. Smith et al., 2003, 25. Tessarolo et al., 2022, 26. Thappa et al., 2023, 27. Van de Putte et al., 2017, 28. Won et al., 2021, 29. Yahaya et al., 2016

Literature Search Methods

DATABASES SEARCHED

- TMC Library, PubMed, CINHAL, Cochrane Library, Clinical Key, Medline
Accessed via Texas Medical Center Library Health Resource Center

MeSH Terms

- ‘Adult’
- ‘Human’
- ‘Intubation’
- ‘Intratracheal’
- ‘Rapid sequence induction’
- ‘Cricoid Cartilage’
- ‘Aspiration’
- ‘Respiratory aspiration of gastric contents’

Key Terms

- Sellick maneuver
- Cricoid pressure
- Left paratracheal pressure
- Rapid sequence induction
- Pulmonary aspiration

Inclusion Criteria

- Adults aged 18 – 75
- Perioperative setting
- Surgery requiring general anesthesia
- Rapid sequence induction

Exclusion Criteria

- Special populations – pediatrics, obstetrics
- High-acuity settings, i.e., ICU or ER

‘Snowballing’ Technique

- Additional literature identified by screening reference lists of initial articles reviewed

Boolean Operators

- ‘AND’ to narrow search
- ‘OR’ to expand search