Airway Management in Trauma

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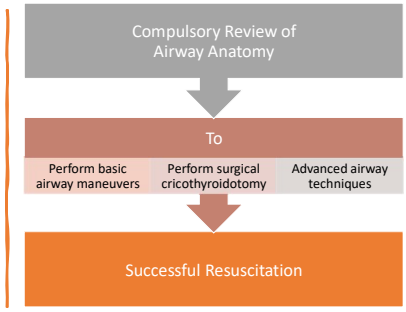
1

Disclosures

- No financial disclosures to make.
- Special acknowledgements to Drs. Joshua Bucher, Richard Levitan, and Reuben Strayer for inspiration/examples.

2

Objectives



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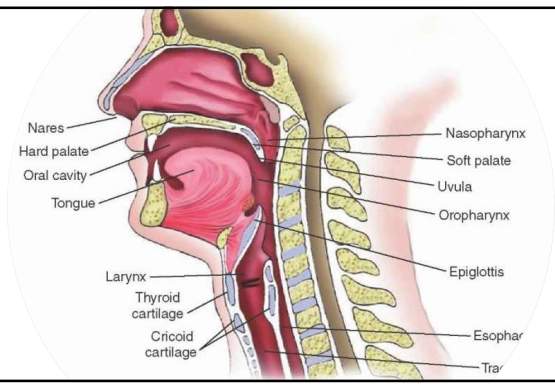
Airway Management Review

4



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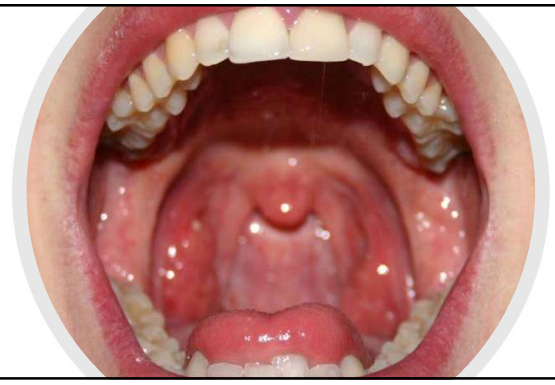

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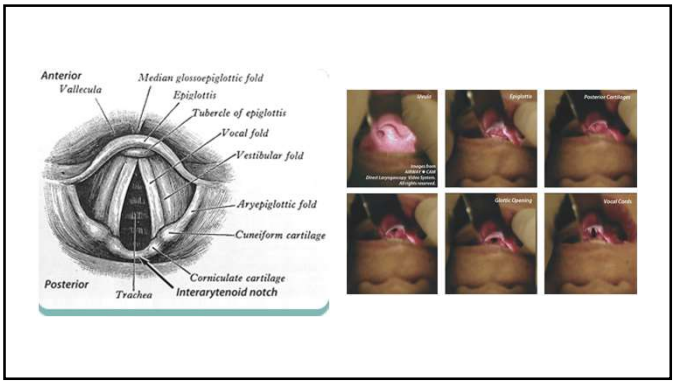
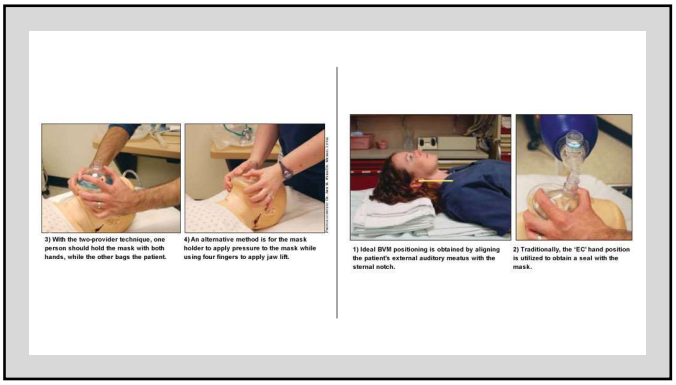

Anterior
Vallecula
Median glossoepiglottic fold
Epiglottis
Tubercle of epiglottis
Vocal fold
Vestibular fold
Aryepiglottic fold
Cuneiform cartilage
Corniculate cartilage
Interarytenoid notch
Posterior
Trachea
Uvula
Epiglottis
Posterior Cartilages
Glottic Opening
Vocal Cords

7


3) With the two-provider technique, one person should hold the mask with both hands, while the other bags the patient.
4) An alternative method is for the mask holder to apply pressure to the mask while using four fingers to apply jaw lift.
1) Ideal BVM positioning is obtained by aligning the patient's external auditory meatus with the sternal notch.
2) Traditionally, the 'EC' hand position is utilized to obtain a seal with the mask.

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Basic Airway Maneuvers

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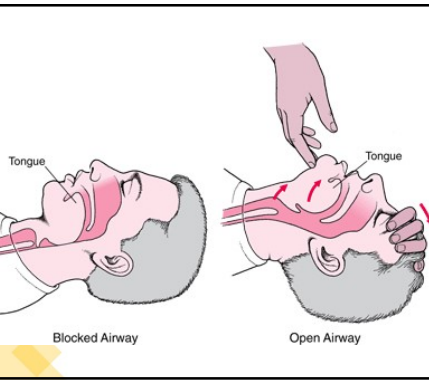

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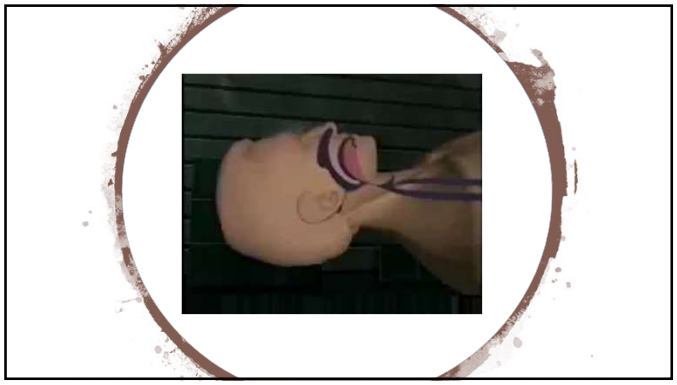

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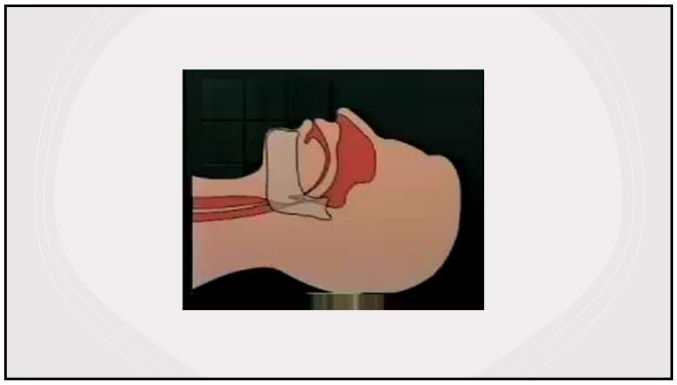

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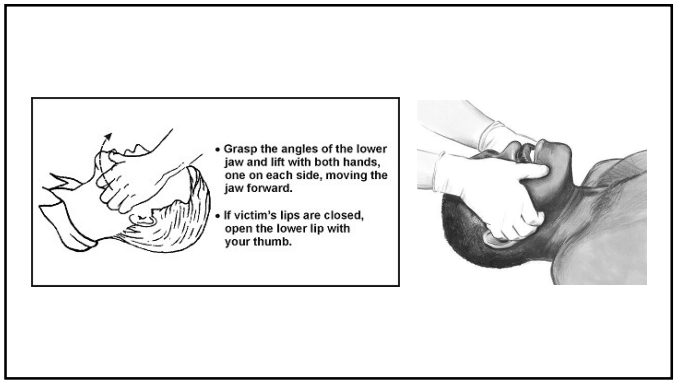
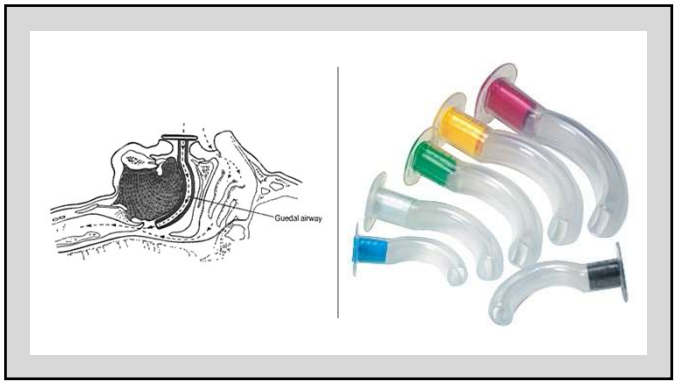

• Grasp the angles of the lower jaw and lift with both hands, one on each side, moving the jaw forward.
• If victim's lips are closed, open the lower lip with your thumb.

15



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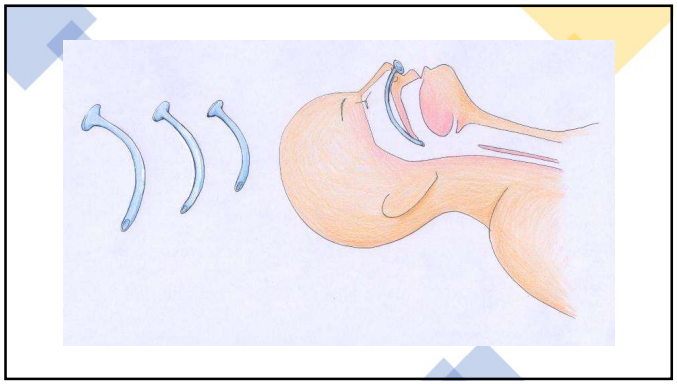

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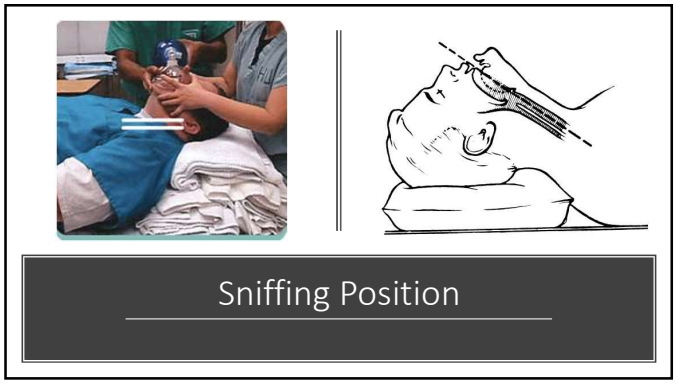

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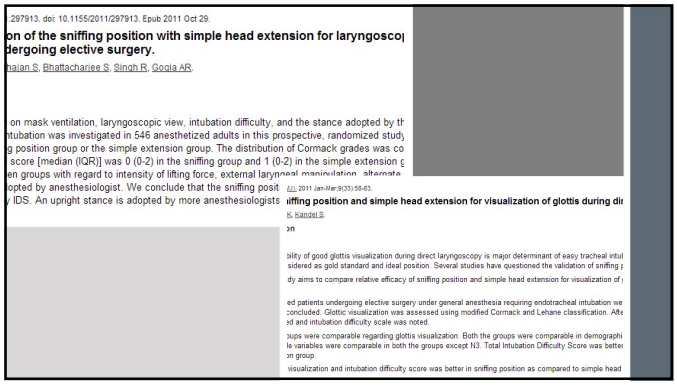


:297913. doi: 10.1155/2011/297913. Epub 2011 Oct 29.

on of the sniffing position with simple head extension for laryngoscop dergoing elective surgery.

haian S, Bhattacharjee S, Singh R, Gogia AR.

on mask ventilation, laryngoscopic view, intubation difficulty, and the stance adopted by th ntubation was investigated in 546 anesthetized adults in this prospective, randomized study g position group or the simple extension group. The distribution of Cormack grades was co score [median (IQR)] was 0 (0-2) in the sniffing group and 1 (0-2) in the simple extension g en groups with regard to intensity of lifting force, external laryngeal manipulation, alternate opted by anesthesiologist. We conclude that the sniffing posit / IDS. An upright stance is adopted by more anesthesiologists

Ed. 2011 Jan-Mar;3(33):58-63.

iiffing position and simple head extension for visualization of glottis during dir

K, Kandel S.

on

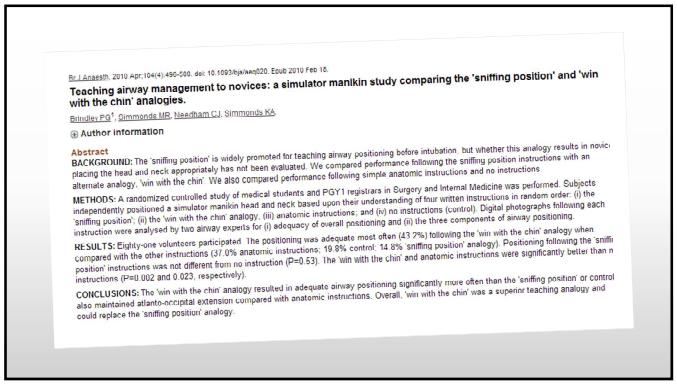
bility of good glottis visualization during direct laryngoscopy is major determinant of easy tracheal intul sidered as gold standard and ideal position. Several studies have questioned the validation of sniffing p dy aims to compare relative efficacy of sniffing position and simple head extension for visualization of g

ed patients undergoing elective surgery under general anesthesia requiring endotracheal intubation we concluded. Glottic visualization was assessed using modified Cormack and Lehane classification. Afte d and intubation difficulty scale was noted.

oups were comparable regarding glottis visualization. Both the groups were comparable in demographi le variables were comparable in both the groups except N3. Total Intubation Difficulty Score was better on group.

visualization and intubation difficulty score was better in sniffing position as compared to simple head

19



Br J Anaesth. 2010 Apr;104(4):490-500. doi: 10.1093/bja/aeq020. Epub 2010 Feb 16.

Teaching airway management to novices: a simulator manikin study comparing the 'sniffing position' and 'win with the chin' analogies.

Bringley PG[1], Simmonds MR, Needham CJ, Simmonds KA

Author information

Abstract

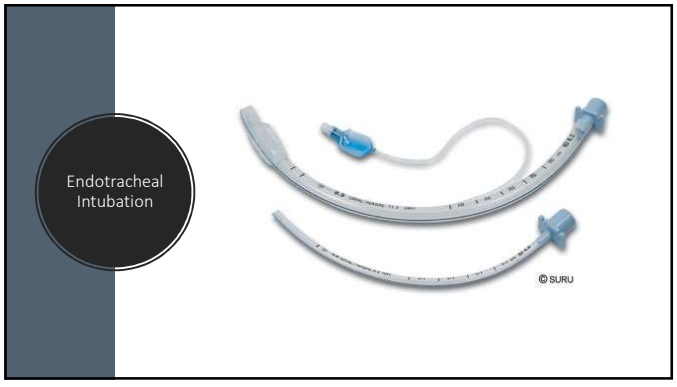
BACKGROUND: The 'sniffing position' is widely promoted for teaching airway positioning before intubation, but whether this analogy results in novic placing the head and neck appropriately has not been evaluated. We compared performance following the sniffing position instructions with an alternate analogy, 'win with the chin'. We also compared performance following simple anatomic instructions and no instructions.

METHODS: A randomized controlled study of medical students and PGY1 registrars in Surgery and Internal Medicine was performed. Subjects independently positioned a simulator manikin head and neck based upon their understanding of four written instructions in random order: (i) the 'sniffing position'; (ii) the 'win with the chin' analogy, (iii) anatomic instructions; and (iv) no instructions (control). Digital photographs following each instruction were analysed by two airway experts for (i) adequacy of overall positioning and (ii) the three components of airway positioning.

RESULTS: Eighty-one volunteers participated. The positioning was adequate most often (43.2%) following the 'win with the chin' analogy when compared with the other instructions (37.0% anatomic instructions; 19.8% control; 14.8% 'sniffing position' analogy). Positioning following the 'sniffi position' instructions was not different from no instruction (P=0.53). The 'win with the chin' and anatomic instructions were significantly better than n instructions (P=0.002 and 0.023, respectively).

CONCLUSIONS: The 'win with the chin' analogy resulted in adequate airway positioning significantly more often than the 'sniffing position' or control also maintained atlanto-occipital extension compared with anatomic instructions. Overall, 'win with the chin' was a superior teaching analogy and could replace the 'sniffing position' analogy.

20



21

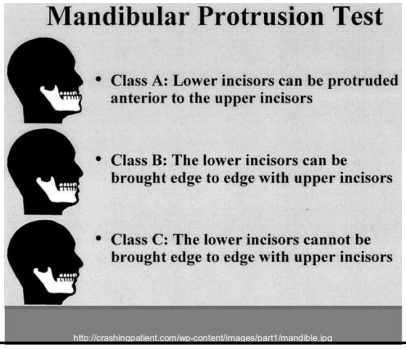
The 6 P's of Rapid Sequence Intubation

Prepare	Assess for intubation difficulty, get your equipment ready, hook the patient up to monitors, get an IV in.
Pre-oxygenate	Pre-oxygenate the patient. Put them on 100% oxygen for at least 5 minutes.
Pre-medicate	Lidocaine can decrease airway responses. Fentanyl decreases sympathetic tone. Atropine decreases the bradycardia caused by succinylcholine. Vecuronium can lessen the fasciculations caused by succinylcholine. Benzodiazepines can prevent the emergence nightmares from ketamine.
Paralysis after sedation	Sedate the patient first, then paralyze. It would not be a pleasant experience to be aware of being paralyzed. So a sedative with rapid onset is important. Typical Sedatives (click to open) Typical Paralytics (click to open)
Placement of the tube	Placement of tube after sedation and paralysis.
Post-intubation Management	Confirmation you didn't accidentally intubate the esophagus: • listen for bilateral breath sounds, • listen for a lack of air in the stomach, • look for symmetric chest rise, • use an end-tidal CO2 detector to look for color change (after at least 6 breaths) • get a chest x-ray to assess for depth of intubation.

22

Are difficult airways predictable?

Mandibular Protrusion Test



- **Class A: Lower incisors can be protruded anterior to the upper incisors**
- **Class B: The lower incisors can be brought edge to edge with upper incisors**
- **Class C: The lower incisors cannot be brought edge to edge with upper incisors**

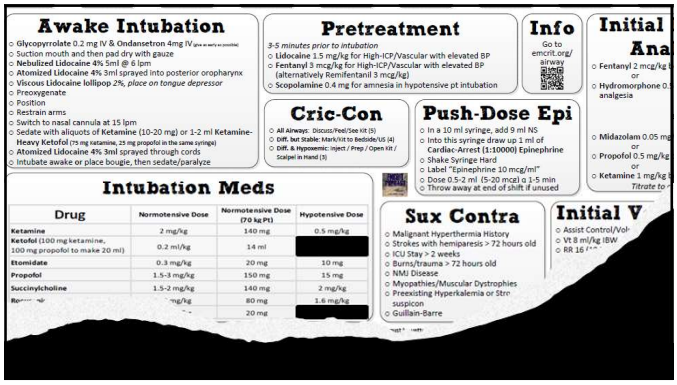
http://crashingpatient.com/wp-content/images/part1/mandible.jpg

23

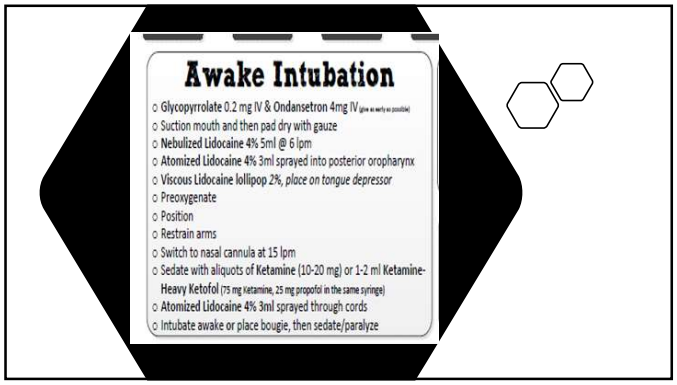
Predictors of a Challenging Airway

- Beard
- Obesity
- No teeth
- > 55 yrs of age
- Snoring
- Mallampati III or IV
- Limited jaw protrusion
- Thyromental distance < 6cm
- Limited neck mobility
- Tracheostomy scar

24


Awake Intubation
Glycopyrrolate 0.2 mg IV & Ondansetron 4mg IV
Suction mouth and then pad dry with gauze
Nebulized Lidocaine 4% 5ml @ 6 lpm
Atomized Lidocaine 4% 3ml sprayed into posterior oropharynx
Viscous Lidocaine lollipop 2%, place on tongue depressor
Preoxygenate
Position
Restrain arms
Switch to nasal cannula at 15 lpm
Sedate with aliquots of Ketamine (10-20 mg) or 1-2 ml Ketamine-Heavy Ketofol (75 mg ketamine, 25 mg propofol in the same syringe)
Atomized Lidocaine 4% 3ml sprayed through cords
Intubate awake or place bougie, then sedate/paralyze
Pretreatment
3-5 minutes prior to intubation
Lidocaine 1.5 mg/kg for High-ICP/Vascular with elevated BP
Fentanyl 3 mcg/kg for High-ICP/Vascular with elevated BP (alternatively Remifentanil 3 mcg/kg)
Scopolamine 0.4 mg for amnesia in hypotensive pt intubation
Info
Go to emcrit.org/airway
Initial Ana
Fentanyl 2 mcg/kg
or
Hydromorphone 0.
analgesia
Midazolam 0.05 mg
or
Propofol 0.5 mg/kg
or
Ketamine 1 mg/kg
Titrate to
Cric-Con
All Airways: Discuss/Feel/See Kit (5)
Diff. but Stable: Mark/Kit to Bedside/US (4)
Diff. & Hypoxemic: Inject / Prep / Open Kit / Scalpel in Hand (3)
Push-Dose Epi
In a 10 ml syringe, add 9 ml NS
Into this syringe draw up 1 ml of Cardiac-Arrest (1:10000) Epinephrine
Shake Syringe Hard
Label "Epinephrine 10 mcg/ml"
Dose 0.5-2 ml (5-20 mcg) q 1-5 min
Throw away at end of shift if unused
Intubation Meds
Drug | Normotensive Dose | Normotensive Dose (70 kg Pt) | Hypotensive Dose
Ketamine | 2 mg/kg | 140 mg | 0.5 mg/kg
Ketofol (100 mg ketamine, 100 mg propofol to make 20 ml) | 0.2 ml/kg | 14 ml
Etomidate | 0.3 mg/kg | 20 mg | 10 mg
Propofol | 1.5-3 mg/kg | 150 mg | 15 mg
Succinylcholine | 1.5-2 mg/kg | 140 mg | 2 mg/kg
80 mg | 1.6 mg/kg
20 mg
Sux Contra
Malignant Hyperthermia History
Strokes with hemiparesis > 72 hours old
ICU Stay > 2 weeks
Burns/trauma > 72 hours old
NMJ Disease
Myopathies/Muscular Dystrophies
Preexisting Hyperkalemia or Str
suspicon
Guillain-Barre
Initial V
Assist Control/Vol
Vt 8 ml/kg IBW
RR 16

25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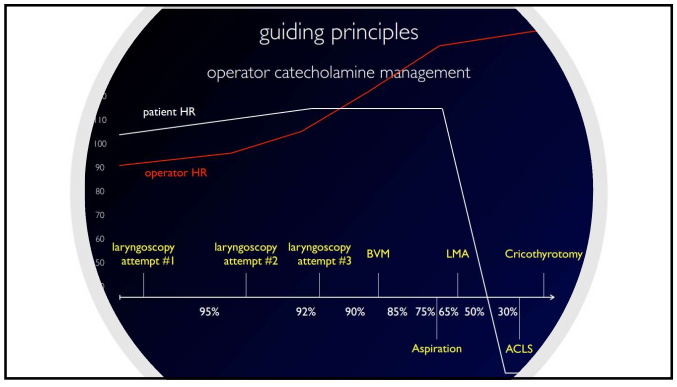
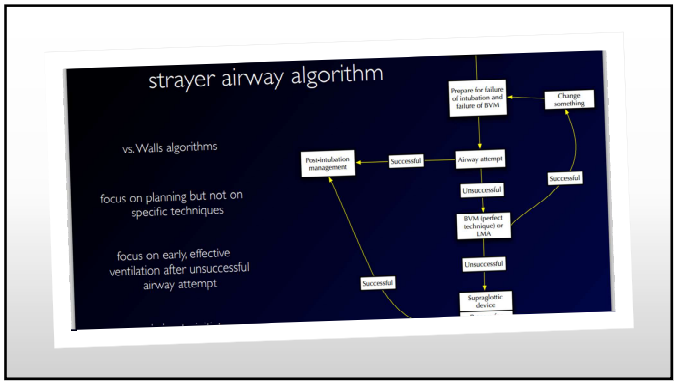

guiding principles
operator catecholamine management
patient HR
operator HR
laryngoscopy attempt #1
laryngoscopy attempt #2
laryngoscopy attempt #3
BVM
LMA
Cricothyrotomy
95%
92%
90%
85%
75%
65%
50%
30%
Aspiration
ACLS

27



28

Lee BJ, Kang JM, Kim DO (2007) Laryngeal exposure during laryngoscopy is better in the 25 degrees back-up position than in the supine position. Br J Anaesth 99:581586)

29

J Clin Anesth. 2002 Aug;14(5):335-8.

Head and neck elevation beyond the sniffing position improves laryngeal view in cases of difficult direct laryngoscopy.

Schmitt HJ[1], Mang H.

Br J Anaesth. 2007 Oct;99(4):581-6. Epub 2007 Jul 4.

Laryngeal exposure during laryngoscopy is better in the 25 degrees back-up position than in the supine position.

Lee BJ[1], Kang JM, Kim DO.

Anesth Analg. 2005 Dec;101(6):1910-5. doi: 10.1213/01.ANE.0000184556.ed.

Laryngoscopy and tracheal intubation in the head-elevated position in obese patients: a randomized, controlled, equivalence trial.

Rao SL[1], Kanselaar AR, Schuler HG, DeaHamais S

Author information

Am Emerg Med. 2003 Mar;41(3):322-30.

Head-elevated laryngoscopy position: improving laryngeal exposure during laryngoscopy by increasing head elevation.

Levitan RM[1], Mechem CC, Ochroch EA, Shofer FS, Hollander JE.

30

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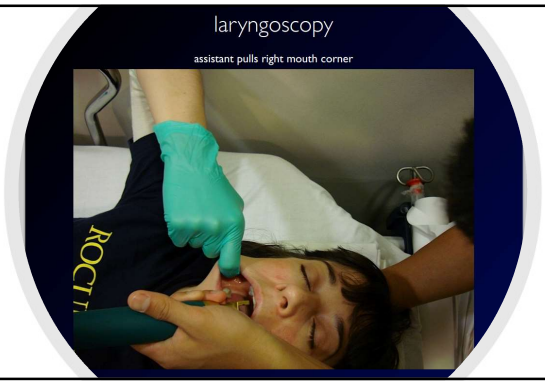
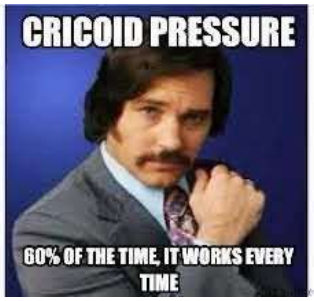


32

“But doc, what about cricoid pressure?”



33

J Anaesthesiol Clin Pharmacol. 2014 Jan;30(1):3-6. doi: 10.4103/0970-9185.125683.

Cricoid pressure: Where do we stand?

Bhatia N, Bhagat H, Sen I.

Author information

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.

KEYWORDS: Anesthesia; Sellick maneuver; cricoid pressure

PMID: 24574584 [PubMed] PMCID: PMC3927288 Free PMC Article

34

J Emerg Med. 2012 May;42(5):606-11. doi: 10.1016/j.jemermed.2011.05.014. Epub 2011 Jun 12.

Cricoid pressure provides incomplete esophageal occlusion associated with lateral deviation: a magnetic resonance imaging study.

Boet S[1], Duffchen K, Chan J, Chan AW, Morrish W, Ferland A, Hare GM, Hong AP.

Author information

Abstract

BACKGROUND: Cricoid pressure is a routine component of rapid sequence induction and is designed to reduce the risk of reflux and its associated morbidity. Recent studies have raised questions regarding the efficacy of cricoid pressure in terms of changes in the pharyngeal and esophageal anatomy.

OBJECTIVE: This current descriptive study was designed to observe the anatomical effect of cricoid pressure on the occlusion of esophageal lumen in conscious volunteers using magnetic resonance imaging (MRI).

METHODS: We quantitatively assessed esophageal patency before and during application of cricoid pressure in 20 awake volunteers utilizing MRI.

RESULTS: Target cricoid pressure was achieved in 16 of 20 individuals, corresponding to a mean percentage reduction in cricovertebral distance of 43% (range 25-80%). Cricoid pressure was applied incorrectly in 4 (20%) individuals as evidenced by no change in the cricovertebral distance. Incomplete esophageal occlusion was seen in 10 of 16, or 62.5% (95% confidence interval 35-85%) of individuals when appropriate cricoid pressure was applied. Incomplete esophageal occlusion was always associated with a lateral deviation of the esophagus. None of the 6 subjects with complete occlusion had esophageal deviation during the appropriate application of cricoid pressure.

CONCLUSION: Effective application of cricoid pressure by an experienced operator frequently resulted in lateral deviation of the esophagus and incomplete occlusion of esophageal lumen. Reliance on cricoid pressure for esophageal occlusion requires further evaluation utilizing functional studies.

PMID: 21669510 [PubMed - indexed for MEDLINE]

35

Resuscitation. 2010 Jul;81(7):810-6. doi: 10.1016/j.resuscitation.2010.02.023. Epub 2010 Apr 15.

Cricoid pressure and laryngeal manipulation in 402 pre-hospital emergency anaesthetics: essential safety measure or a hindrance to rapid safe intubation?

Harris T[1], Ellis DY, Foster L, Lockey D.

Author information

Abstract

OBJECTIVES: This is the first study to look at the effects of cricoid pressure/laryngeal manipulation on the laryngeal view and intubation success in the emergency or pre-hospital environment. Cricoid pressure is applied in the hope of reducing the incidence of aspiration. However the technique has never been evaluated in a randomized trial and may adversely affect laryngeal view. In order to improve intubating conditions cricoid pressure may be released and the larynx manipulated into a more favourable position.

METHODS: We carried out a prospective observational study to evaluate the effects of cricoid pressure and laryngeal manipulation on laryngeal view in our physician led pre-hospital trauma service.

RESULTS: 402 patients were included over a 16-month period. We intubated 98.8% patients on the first or second attempt. In 61 intubations (in 55 patients, 13.6%) the larynx required manipulation to facilitate intubation. In 22 intubations cricoid pressure was removed with the laryngeal view improving in 50%. Bimanual laryngeal manipulation was used in 25 intubations and the larynx better visualised in 60% of these. Backwards upwards rightwards pressure was applied to the larynx in 14 intubations and the laryngeal view improved in 64%. Two patients regurgitated when cricoid pressure was released. Both had prolonged periods of bag valve mask ventilation and difficult intubations.

DISCUSSION: The results suggest that cricoid pressure should be removed if the laryngeal view obtained is not sufficient to allow immediate intubation. Further manipulation of the larynx is likely to improve the chances of successful tracheal tube placement.

Comment in

Correct use of cricoid pressure in pre-hospital emergency intubation. [Resuscitation. 2011]

PMID: 20398995 [PubMed - indexed for MEDLINE]

36

Ann Emerg Med. 2006 Jun;47(6):548-55. Epub 2006 Mar 14.

Laryngeal view during laryngoscopy: a randomized trial comparing cricoid pressure, backward-upward-rightward pressure, and bimanual laryngoscopy.

Levitan RM[1], Kinkle WC, Levin WJ, Everett WW.

Author information

Abstract

STUDY OBJECTIVE: External cricoid and thyroid cartilage manipulations are commonly taught to facilitate laryngeal view during intubation. We compare the laryngeal views during laryngoscopy with 4 manipulations (no manipulation, cricoid pressure, backward-upward-rightward pressure [BURP], and bimanual laryngoscopy) to determine the method that optimizes laryngeal view.

METHODS: This was a randomized intervention study involving emergency physicians participating in airway training courses from December 2003 to November 2004. Direct laryngoscopies were performed with curved blades on fresh, non-fixed cadavers by using each of the 4 methods. The percentage of glottic opening (POGO), a validated scoring scale, was recorded for each laryngoscopy. Scores for bimanual laryngoscopy were recorded before the assistant applied external pressure.

RESULTS: A total of 1,530 sets of comparative laryngoscopies were performed by 104 participants. One thousand one hundred eighteen of 1,530 sets (73%) had POGO scores less than 100 with no manipulation. Compared to no manipulation, mean POGO scores with bimanual laryngoscopy improved by 25 (95% confidence interval [CI] 23 to 27); mean POGO score improvement with cricoid pressure and BURP were 5 (95% CI 3 to 8) and 4 (95% CI 1 to 7), respectively. POGO scores with bimanual laryngoscopy were higher compared to cricoid pressure (mean difference 20, 95% CI 17 to 22) and BURP (mean difference 21, 95% CI 19 to 24). Among laryngoscopies with no manipulation in which the POGO score greater than 0 (n=1,434), laryngeal view worsened in 60 cases (4%, 95% CI 3% to 5%) with bimanual laryngoscopy, in 409 cases (29%, 95% CI 26% to 31%) with cricoid pressure, and in 504 cases (35%, 95% CI 33% to 38%) with BURP.

CONCLUSION: Using a cadaver model, we found pressing on the neck during curved blade laryngoscopy greatly affects laryngeal view. Overall, bimanual laryngoscopy improved the view compared to cricoid pressure, BURP, and no manipulation. Cricoid pressure and BURP frequently worsen laryngoscopy. These data suggest bimanual laryngoscopy should be considered when teaching emergency airway management.

PMID: 16713784 [PubMed - indexed for MEDLINE]

37

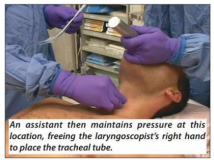
laryngoscopy

optimize the larynx: use your right hand to maneuver the thyroid cartilage into optimal position

28

38

Bimanual laryngoscopy. The force on the neck is opposite direction of lift by the laryngoscope.



An assistant then maintains pressure at this location, freeing the laryngoscopist's right hand to place the tracheal tube.

The AIRWAY•CAM Pocket Guide to Intubation, Richard M. Levitan, MD

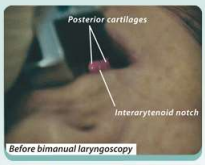
39

J Clin Anesth. 1996 Mar;8(2):136-40.

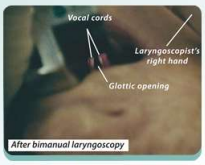
Quantitative improvement in laryngoscopic view by optimal external laryngeal manipulation.

Benumof JL[1], Cooper SD.

Bimanual laryngoscopy transforms a poor laryngeal view



Initial view demonstrates posterior cartilages and interarytenoid notch.



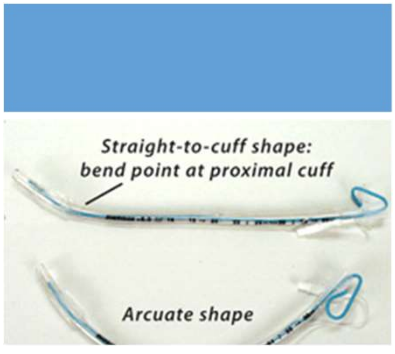
With bimanual laryngoscopy, the glottic opening and true vocal cords are well seen.

40

laryngoscopy

advance the ETT or bougie from the right side and twist, do not lever

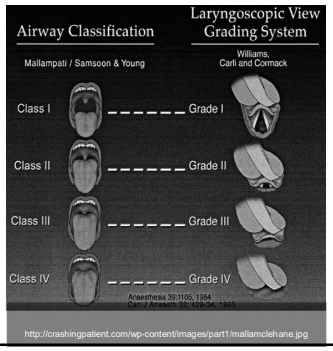
41



Straight to cuff with 35 degree bend probably is best

ACADEMIC EMERGENCY MEDICINE2006;13:1251258

42



43

Contraindications to rocuronium?

roc vs. sux

problems with succinylcholine

K

rhabdomyolysis
existing hyperkalemia
multiple sclerosis
ALS
muscular dystrophies / inherited myopathies
denervating injuries > 72 hours old (e.g. stroke, spinal cord injury)
burns > 72 hours old
crush injury > 72 hours old
tetanus, botulism, and other exotoxin infections
severe infections >72 hours old (esp. intra-abdominal infections)
immobilization (including patients found down)

predisposition to malignant hyperthermia
bradycardia
fasciculations – increased ICP, myalgias, hastened desaturation
masseter spasm

42

44

Preoxygenation

45

AIRWAY/REVIEW ARTICLE

Preoxygenation and Prevention of Desaturation During Emergency Airway Management

Scott D. Weingart, MD, Richard M. Levitan, MD

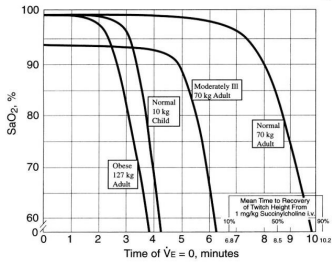
From the Division of Emergency Critical Care, Department of Emergency Medicine, Mount Sinai School of Medicine, New York, NY (Weingart); and the Department of Emergency Medicine, Thomas Jefferson University Hospital, Philadelphia, PA (Levitan).

Patients requiring emergency airway management are at great risk of hypoxemic hypoxia because of primary lung pathology, high metabolic demands, anemia, insufficient respiratory drive, and inability to protect their airway against aspiration. Tracheal intubation is often required before the complete information needed to assess the risk of periprocedural hypoxia is acquired, such as an arterial blood gas level, hemoglobin value, or even a chest radiograph. This article reviews preoxygenation and peri-intubation oxygenation techniques to minimize the risk of critical hypoxia and introduces a risk-stratification approach to emergency tracheal intubation. Techniques reviewed include positioning, preoxygenation and denitrogenation, positive end expiratory pressure devices, and passive apneic oxygenation. [Ann Emerg Med. 2012;59:165-175.]

A **podcast** for this article is available at www.annemergmed.com.

46

TIME TO HEMOGLOBIN DESATURATION WITH INITIAL F_AO_2 = 0.87



http://crashingpatient.com/resuscitation/airway/airway.html

47

Anesthesiology:
October 1997 - Volume 87 - Issue 4 - pp 979-982
Special Articles

Critical Hemoglobin Desaturation Will Occur before Return to an Unparalyzed State following 1 mg/kg Intravenous Succinylcholine

Benumof, Jonathan L. MD; Dagg, Rachel MS; Benumof, Reuben PhD

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Received from the Department of Anesthesiology, University of California at San Diego Medical Center, San Diego, California. Submitted for publication January 22, 1997. Accepted for publication June 19, 1997.

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48

Is NRB the best?

- Patient breathing adequately?
  - NRB at 15 lpm?
  - 70 – 80%

Much longer time to desat in the obese if you preoxygenate in sitting position (British Journal of Anaesthesia 2005 95(5):706-709)

49

DOES THE CHOICE OF PARALYTIC AGENT AFFECT PREOXYGENATION?

The choice of paralytic agent may influence the time to desaturation during airway management. In a study of operative patients, the time to desaturation to 95% was 242 seconds in patients receiving succinylcholine versus 378 seconds in a group given rocuronium.[95] Similarly, in obese patients undergoing surgery, the succinylcholine group desaturated to 92% in 283 seconds versus 329 seconds in the rocuronium group.[96] When used at a dose of greater than or equal to 1.2 mg/kg, rocuronium provides intubating conditions identical to those of succinylcholine.[97]

It is hypothesized that the fasciculations induced by succinylcholine may cause increased oxygen use. Pretreatment medications to prevent fasciculations minimize the difference in desaturation times.[95]

Recommendation: In patients at high risk of desaturation, rocuronium may provide a longer duration of safe apnea than succinylcholine.

Weingart S. Preoxygenation and Prevention of Desaturation During Emergency Airway Management

50

Ann Fr Anesth Reanim. 2012 Sep;31(9):e161-5. doi: 10.1016/j.annfar.2012.05.003. Epub 2012 Jul 6.

Efficacy of preoxygenation with non-invasive low positive pressure ventilation in obese patients: crossover physiological study.

Georgescu M[1], Tanoubi I, Fortier LP, Donati F, Drolet P.

Author information

Abstract

OBJECTIVE: The impact of non-invasive positive pressure ventilation (NIPPV), which is a combination of inspiratory positive airway pressure (IPAP) and positive end expiratory pressure (PEEP), on the effectiveness of preoxygenation in obese patients was evaluated.

DESIGN: Randomized, controlled, double blinded, crossover study comparing NIPPV vs. tidal volume breathing (TVB) with regard to the expiratory O(2) fraction (FeO(2)).

PATIENTS AND METHODS: Thirty participants with body mass index (BMI) greater or equal to 30 kg/m(2) scheduled for elective surgery were included. Patients with facial hair, and airway anomalies were excluded. Each patient underwent 3 minutes 100% O(2) preoxygenation with the two following methods in a random order: 1: TVB; 2: NIPPV (4 cmH(2)O IPAP+4 cmH(2)O PEEP). Primary outcome was FeO(2) after 3 minutes. Secondary outcomes were the number of patients reaching FeO(2) greater or equal to 90%, tidal volume, respiratory rate, and patient comfort on a 4-point scale.

RESULTS: No differences between methods were found regarding the FeO(2) change with time or after 3 minutes (89 ± 6% with TBV vs. 91 ± 4% with NIPPV). FeO(2) greater or equal to 90% was reached more frequently with NIPPV (80%) than with TVB (60%) (P=0.008). Tidal volume (m ± SD) was larger throughout preoxygenation with TBV (837 ± 440 mL) than with NIPPV (744 ± 368 mL). (P=0.0005). Respiratory rate did not differ between regimens. Patient comfort was good and similar.

CONCLUSION: This study suggests that providing a positive pressure of 4 cmH(2)O throughout inspiration and expiration during preoxygenation in obese patients provided benefits with regard to the FeO(2).

51

Recommendation: Preoxygenation extends the duration of safe apnea and is recommended for every ED tracheal intubation.

Recommendation: Standard reservoir facemasks with the flow rate of oxygen set as high as possible are the recommended source of high FiO_2 for preoxygenation in the ED.

Recommendation: Patients with an adequate respiratory drive should receive preoxygenation for 3 minutes or take 8 breaths, with maximal inhalation and exhalation.

52

Recommendation: CPAP masks, noninvasive positive-pressure ventilation, or PEEP valves on a bag-valve-mask device should be considered for preoxygenation and ventilation during the onset phase of muscle relaxation in patients who cannot achieve saturations greater than 93% to 95% with high FiO_2.

Figure 2. A disposable PEEP valve. This inexpensive item is a strain gauge capable of PEEP settings from 5 to 20 cm H_2O. When placed on the exhalation port of a bag-valve-mask device (inset), it allows the device to provide PEEP/CPAP when the patient is spontaneously breathing and during assisted ventilations. If combined with a nasal cannula set to 15 L/minute, it will provide CPAP even without ventilations. The generation of positive pressure is predicated on a tight mask seal.

Recommendation: Patients should receive preoxygenation in a head-elevated position whenever possible. For patients immobilized for possible spinal injury, reverse Trendelenburg position can be used.

53

Recommendation: Apneic oxygenation can extend the duration of safe apnea when used after the administration of sedatives and muscle relaxants. A nasal cannula set at 15 L/minute is the most readily available and effective means of providing apneic oxygenation during ED tracheal intubations.

54

Recommendation: Patients should be positioned to maximize upper airway patency before and during the apneic period, using ear-to–sternal notch positioning. Nasal airways may be needed to create a patent upper airway. Once the apneic period begins, the posterior pharyngeal structures should be kept from collapsing backwards by using a jaw thrust. Cricoid pressure may negatively affect apneic oxygenation, but studies examining this question in the setting of modern emergency airway management do not exist to our knowledge.

55

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Journal of Clinical Anesthesia

Original contribution

Apneic oxygenation during prolonged laryngoscopy in obese patients: a randomized, controlled trial of nasal oxygen administration

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Received 11 July 2008; revised 12 May 2009; accepted 27 May 2009

56

Table 2. Risk categorization of patients during preoxygenation.*

Risk Category, Based on Pulse Oximetry While Receiving High-Flow Oxygen	Preoxygenation Period (3 Minutes)	Onset of Muscle Relaxation (~60 Seconds)	Apneic Period During Tracheal Intubation (Variable Duration, Depending on Airway Difficulty; Ideally <30 Seconds)
Low risk, SpO_2 96%–100%	Nonrebreather mask with maximal oxygen flow rate	Nonrebreather mask and nasal oxygen at 15 L/min	Nasal oxygen at 15 L/min
High risk, SpO_2 91%–95%	Nonrebreather mask or CPAP or bag-valve-mask device with PEEP	Nonrebreather mask, CPAP, or bag-valve-mask device with PEEP and nasal oxygen at 15 L/min	Nasal oxygen at 15 L/min
Hypoxemic, SpO_2 90% or less	CPAP or bag-valve-mask device with PEEP	CPAP or bag-valve-mask device with PEEP and nasal oxygen at 15 L/min	Nasal oxygen at 15 L/min

*Risk categories are based on patient's initial response to high-flow oxygen through a tightly fitting nonrebreather mask. Patients who are already hypoxemic exhibit shunt physiology and are prone to rapid desaturation during the peri-intubation. Patients with saturations of 91% to 95% have values close to the precipice of the steep portion of the oxyhemoglobin dissociation curve and should be considered high risk. Patients with saturations greater than or equal to 96% are at low risk for peri-intubation desaturation. Patients in all risk categories should receive preoxygenation in a head-elevated position (or reverse-Trendelenburg if there is a risk of spine injury).

57

Sequence of Preoxygenation and Prevention of Desaturation

(Assuming 2 oxygen regulators*)

Preoxygenation Period

- Position the patient in a semi-recumbent position (~20°) or in reverse Trendelenberg. Position the patient's head in the ear-to-sternal-notch position using padding if necessary.
- Place a nasal cannula in the patient's nares. Do not hook the nasal cannula to oxygen regulator.
- Place patient on a non-rebreather mask at the maximal flow allowed by the oxygen regulator (at least 15 lpm, but many allow a much greater uncalibrated flow)
- If patient is not saturating > 90%, remove face mask and switch to non-invasive CPAP by using ventilator, non-invasive ventilation machine, commercial CPAP device, or BVM with PEEP valve attached. Titrate between 5-15 cm H_2O of PEEP to achieve an oxygen saturation > 98%. Consider this step in patients saturating 91-95%.
- Allow patient to breath at tidal volume for 3 minutes or ask the patient to perform 8 maximal exhalations and inhalations
- Attach a BVM to oxygen regulator and set it to maximal flow (at least 15 lpm). If the patient required CPAP for preoxygenation, attach a PEEP valve to the BVM set at the patient's current CPAP level

Apneic Period

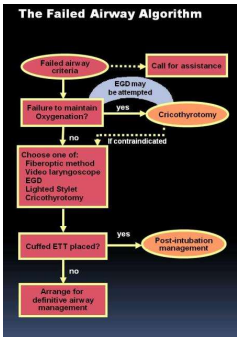
- Push sedative and paralytic (preferably rocuronium, if the patient is at risk for rapid desaturation)
- Detach face mask from the oxygen regulator and attach the nasal cannula. Drop the flow rate to 15 lpm.
- Remove the face mask from the patient.
- Perform a jaw thrust to maintain pharyngeal patency.
- If the patient is high risk (required CPAP for preoxygenation), consider leaving on the CPAP during the apneic period or providing 4-6 ventilations with the BVM with a PEEP valve attached. Maintain a two-hand mask seal during the entire apneic period to maintain the CPAP.

Intubation Period

- Leave the nasal cannula on throughout the airway management period to maintain apneic oxygenation.

* If 3 regulators are available, attach reservoir face mask, BVM, and nasal cannula to them. If only one regulator is available, consider using a stand-alone oxygen tank to offer a second source of oxygen.

58



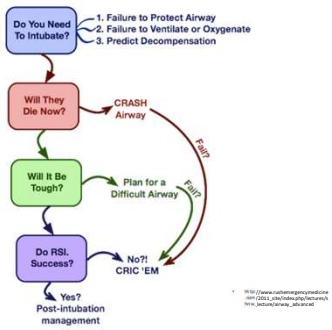
Can't Intubate/Can't Ventilate or three failed attempts

Best Attempt Definition:

- Performed by a reasonably experienced laryngoscopist
- No significant muscle tone
- Use of optimal sniff position
- Use of external laryngeal manipulation
- One change in length of blade
- One change in type of blade

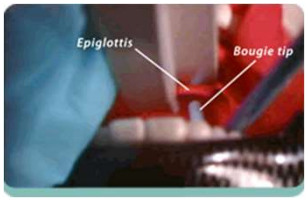
http://crashingpatient.com/resuscitation/airway/airway.html

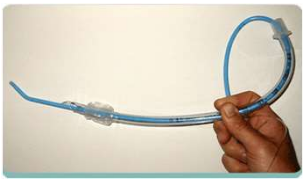
59



60

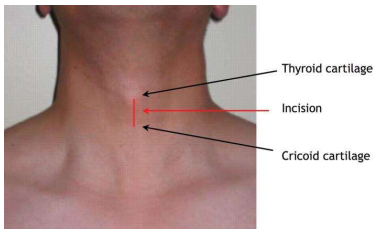
Use a Bougie Every Time





61

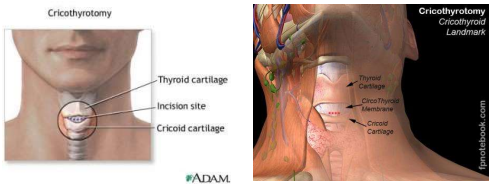
Cricothyrotomy



62

What do you need?

63


Cricothyrotomy
Thyroid cartilage
Incision site
Cricoid cartilage
A.D.A.M.
Cricothyrotomy
Cricothyroid
Landmark
Thyroid Cartilage
CricoThyroid Membrane
Cricoid Cartilage
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64

65

66

In summary…

- Mastery of basic airway anatomy will prove invaluable when things aren't so straightforward.
- Plan and prepare for difficult airways.
- Apply these principles to traumatic airways that may have gross contamination or anatomic distortion.
- Remember the hardest step in performing a cricothyrotomy!

67