SWESEMs utbildningsutskott

Rubrik

Endotrakeal intubation

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Introduktion

Endotrakeal intubation är gold standard för en säker luftväg[1]. Endotrakeal intubation kan också användas för att åtgärda en övre luftvägsobstruktion orsakad av en subglottisk främmande kropp[2]. Hos patienter med hjärtstopp möjliggör endotrakeal intubation ventilation under oavbrutna kompressioner; överlevnadsvinst har dock inte bevisats[3]. Hos akutpatienter utan hjärtstopp genomförs endotrakeal intubation i regel med hjälp av snabbverkande läkemedel, som en ”Rapid Sequence Intubation” (RSI).[4]

Endotrakeal intubation kan leda till allvarliga komplikationer. Ingreppets svårighetsgrad ökar bland annat hos barn och i prehospital miljö. Misslyckad eller esofagusintubation ger risk för allvarlig hypoxi och bestående men. Val av läkemedel och dos för RSI kräver kunskap och erfarenhet. Patientens känslighet för läkemedel beror på individuella faktorer, ålder, komorbiditeter och allmäntillstånd. Feldosering kan leda till cirkulatorisk kollaps. Adekvat ventilation kan i regel uppnås med basala luftvägsmanövrar, ventilation med mask och blåsa eller larynxmask; intubation kan då anstå till ankomst av erfaren personal. Fall med hög komplikationsrisk vid intubation vakenintuberas med fiberskop, och vid fall med högt luftvägshinder (munbottenflegmone, kraftigt angioödem) kan kirurgisk luftväg vara att föredra.

Specialister i akutsjukvård bör kunna indikationerna och kontraindikationerna för endotrakeal intubation. De bör kunna genomföra intubation vid hjärtstopp eller under kritiska situationer om personal med högre luftvägskompetens inte är tillgänglig. Endotrakeal intubation kan underlättas av videolaryngoskop/fiberskop, men förmågan att använda vanligt laryngoskop är nödvändig[5]. Dokumentet gäller även för barn.

Endotrakeal intubation på akuten görs inte så ofta och bör därför övas genom simulation. Det är lämpligt att redan före en akut situation uppstår, ha iordningställt och gjort sig förtrogen med den utrustning man behöver. Proceduren behövs i en situation som redan är stressande för patienten och vårdteamet, där många andra åtgärder är på gång. Teamets uppmärksamhet behöver samlas, assistent(er) instrueras och teamledaren (och vaken patient) får återkoppling på hur proceduren fortgår och dess resultat. Därför finns i checklistan både en punkt att teamet informeras innan proceduren påbörjas, och en helhetsbedömning avseende manuell färdighet och kommunikativ kompetens. Helhetsbedömningen sker ur ett patientsäkerhetsperspektiv att läkaren är förtrogen med utrustning och procedur, hanterar eventuella svårigheter på ett säkert sätt, och kan kommunicera med sitt team. Innan själva intubationen görs, måste läkaren ha gjort en plan B – en plan för vad man ska göra om intubationen misslyckas.

I specialisttentamen

I specialisttentamen bedöms endotrakeal intubation med vanligt laryngoskop på patienter i alla åldersgrupper. Läkemedel och doser omfattas inte. I momentet ingår bedömning av luftvägens svårighetsgrad. Läkaren blir underkänd vid intubationsförsök som överstiger 30 sekunders apnétid för patienten. Om 30 sekunder har gått ska man ventilera med mask och blåsa tills patient och Läkare är redo för nästa försök. Godkänd manuell färdighet och kommunikativ kompetens är obligatoriskt för godkänt moment. I tentamen kommuniceras med examinatorn, som om denna vore medlem i teamet.

Indikationer[6]

- Hjärtstopp eller akut andningsstopp
- Otillräcklig oxygenering eller ventilation
- Aspirationsrisk (ex medvetandesänkning)
- Luftvägsobstruktion
- Kliniskt förlopp där intubationsindikation kan förutses

Kontraindikationer[7]

- Partiell transektion (avslitning) av trakea

1-Förbereder patienten[8]

- ☐ Optimerar, britsens höjd, patientens plats på britsen och huvudets position[30-32]
- ☐ Monitorerar patientens vitala funktioner (pulsoximeter[11], blodtryck, 3-avl EKG[14])
- ☐ Etablerar/kontrollerar intravenös/-osseös infart[12] och kopplar infusion Ringer[13]
- ☐ Kontrollerar medvetande och om nervstatus behövs göras före intubation
- ☐ Bedömer luftvägen (intubationssvårighet) enligt minneshjälpen LEMON©[26]

2-Förbereder utrustning och team[8,16]

- ☐ Kontrollerar hur säng/brits tippas
- ☐ Skyddsutrustning (handskar, plastförkläde; vb munskydd, ögonskydd)[17]
- ☐ Kontrollerar laryngoskop och blad[18]: rätt typ, storlek, lampa
- ☐ Kontrollerar och har grov sug påslagen och inom räckhåll[19]
- ☐ Tuber[20] av förväntad storlek + storlek större och mindre, samt kontrollerar kuffen[21]
- ☐ Ledare / Bougieledare (Eshmann) och utser assistent som drar ledaren / trär på tuben[22]
- ☐ Blåsa kopplad till syrgas, passande mask[23], svalgtub[24]
- ☐ Stetoskop[43] och kapnograf[44]
- ☐ Material för att fixera tuben[25]
- ☐ Kontrollerar uppdragna läkemedel i märkta sprutor[15]
- ☐ Informerar teamet om ”plan A” och verifierar assistenters roller
- ☐ Informerar teamet om “plan B” t ex larynxmask, coniotomi[27] och om utrustning behöver förberedas

3-Procedur

- ☐ Preoxygenerar med 100 % syrgas och tätslutande mask, helst 3 min eller 8 djupa andetag[10]
- ☐ Ordinerar läkemedel (hypnotika, analgetika, muskelrelax)[28]
- ☐ Håller laryngoskopet i vänster hand så nära bladet som möjligt
- ☐ För laryngoskopet till höger om tungan, och för tungan till vänster[33]
- ☐ Lyfter i laryngoskopskaftets riktning[34], för in bladspetsen i valecula och visualiserar larynx[35]

- ☐ Tar emot tuben utan att släppa larynx med blicken
- ☐ För in tuben till adekvat djup under visualisering och utan våld[37]
- ☐ Ser till att tuben är manuellt fixerad tills den är tejpad eller motsvarande (håller i tuben nära hudplanet med stöd mot patientens kind)
- ☐ Fyller kuffen med 5-10 ml luft [39]
- ☐ Ansluter Rubens blåsa till tuben och ventilerar

Om intubation inte är framgångsrik inom 30 sekunder[40]:

- ☐ Cricoidtryck[41]
- ☐ Ventilerar med mask och blåsa[42]
- ☐ Överväger nytt försök eller går över till plan B (t ex larynxmask) [43]

4-Kontroll

- ☐ Auskulterar över magen och lungorna midaxillärt[43]
- ☐ Kapnometri eller kapnografi under ≥ 6 andetag[44]
- ☐ Sätter svalgtub / bitblock[45]
- ☐ Fixerar tuben[46]
- ☐ Kontrollerar/justerar kufftryck
- ☐ Dokumenterar avstånd tubspets - framtänder[38]

Fortsatt handläggning:

- ☐ Plan för fortsatt sömn, ventilation och monitorering[48]

Helhetsbedömning

- ☐ **Patientens apnétid < 30 sekunder**

Genomför färdigheten med tillräcklig:

- ☐ **Manuell färdighet***
- ☐ **Kommunikativ kompetens***

*för att bedömas säkert genomförd för patient och teammedlemmar.

Exempel på åtgärder som kan behövas, och bedöms i förekommande fall:

- ☐ *Suger i befintlig v-sond, tar bort tandprotes, rensuger munhålan*[29]
- ☐ *Bimanuell laryngoskopi eller BURP (backward upward rightward pressure)*[36]
- ☐ *Använder ledare vid behov och instruerar assistent på säkert sätt*
- ☐ *Suger rent blod/aspirat i tuben*[47]
- ☐ *Sätter v-sond efter intubation och tömmer ventrikeln om inte redan gjort*

ANTECKNINGAR

1-Gold Standard
"Endotracheal intubation is the most reliable way to ensure a patent airway, provide oxygenation and ventilation, and prevent aspiration." (Tintinalli 2011 Chapter 30)

2-Främmande kropp
"A foreign body that is lodged below the vocal cords may completely obstruct the subglottic trachea. This obstruction cannot be removed with direct laryngoscopy. In this situation, we recommend that the trachea be intubated and the endotracheal tube advanced into the right mainstem bronchus. This maneuver is an attempt to relieve the tracheal obstruction by pushing it into the right mainstem bronchus. At this point, the endotracheal tube should be withdrawn to a position above the carina. The left lung can then be ventilated." (Loftis 2012)

3-Cardiac arrest
"Tracheal intubation provides the most reliable airway, but should be attempted only if the healthcare provider is properly trained and has regular, ongoing experience with the technique. Personnel skilled in advanced airway management should attempt laryngoscopy and intubation without stopping chest compressions; a brief pause in chest compressions may be required as the tube is passed through the vocal cords, but this pause should not exceed 10 s. Alternatively, to avoid any interruptions in chest compressions, the intubation attempt may be deferred until return of spontaneous circulation. No studies have shown that tracheal intubation increases survival after cardiac arrest. After intubation, confirm correct tube position and secure it adequately. Ventilate the lungs at 10 breaths/min; do not hyperventilate the patient. Once the patient's trachea has been intubated, continue chest compressions, at a rate of 100 /min without pausing during ventilation." (Nolan 2010)

4-Rapid Sequence Intubation
"Rapid-sequence intubation (RSI) is the simultaneous administration of an induction agent and neuromuscular blocking agent to facilitate endotracheal intubation. It is the method of choice for emergency airway management. RSI is associated with the highest intubation success rate in the majority of emergency airway cases and is superior to sedation alone. There are two circumstances in which RSI may not be the first technique of choice. Patients in cardiac or respiratory arrest, or near-arrest, in whom a response to laryngoscopy is unlikely and time is very limited, may be intubated without pharmacologic assistance. The second exception is patients with anticipated airway difficulties in whom the risks of failed intubation, bag-mask ventilation, or rescue are considered too high to remove the patient's airway protection and respirations with paralysis." (Tintinalli 2011 Chapter 30)

5-Intubation med direkt laryngoskopi
"Despite the proliferation of approaches and devices designed to secure a definitive airway, direct laryngoscopy remains the mainstay of tracheal intubation. The equipment is simple and the approach direct. Visual confirmation of the tube going through the vocal cords is usually possible." (McGill 2009)

6-Indikationer för intubation
- Hjärtstopp eller akut andningsstopp (Barker 2012)
- Otillräcklig oxygenering eller ventilation (Walls 2009, Barker 2012)
- Oförmåga att skydda luftvägar från aspiration (Walls 2009, Barker 2012)

- Luftvägsobstruktion (Barker 2012)
- Kliniskt förlopp där intubationsindikation kan förutses (Walls 2009)

“A decision to intubate should be based on careful assessment of the patient with respect to three essential criteria: (1) failure to maintain or protect the airway, (2) failure of ventilation or oxygenation, and (3) the patient's anticipated clinical course and likelihood of deterioration” (Walls 2009)

“Testing the gag reflex in an obtunded, supine patient is unlikely to yield useful information with respect to the need to intubate and may precipitate vomiting. The patient's ability to swallow or handle secretions is a more reliable indicator of airway protection.[5] The recommended approach is to evaluate the patient's ability to phonate in response to voice command or query (which provides information about level of consciousness and voice quality), level of consciousness, and ability to manage his or her own secretions (e.g., pooling of secretions in the oropharynx, absence of swallowing spontaneously or to command.) In general, a patient who requires a maneuver to establish a patent airway or who easily tolerates an oral airway probably requires intubation for protection of that airway, unless a temporary or readily reversible condition, such as opioid overdose, is present.” (Walls 2009)

“Ventilatory failure that is not reversible by clinical means or increasing hypoxemia that is not adequately responsive to supplemental oxygen is a primary indication for intubation. This assessment is clinical and includes evaluation of the patient's general status, oxygenation by pulse oximetry, and changes in the ventilatory pattern. Continuous capnography also can be helpful, but is not essential if oximetry readings are reliable. Arterial blood gases (ABGs) generally are not required to determine the patient's need for intubation. In most circumstances, clinical assessment, including pulse oximetry with or without capnography, and observation of improvement or deterioration lead to a correct decision. . . . Regardless of the underlying cause, the need for mechanical ventilation generally mandates intubation. External mask devices increasingly have been used to provide assisted mechanical ventilation without intubation . . . , but despite these advances, most patients who need assisted ventilation or positive pressure to improve oxygenation require intubation.” (Walls 2009)

“Certain conditions indicate the need for intubation even in the absence of frank airway, ventilatory, or oxygenation failure. These conditions are characterized by a moderate to high likelihood of predictable deterioration that would require airway intervention. Intubation may be indicated relatively early in the course of severe cyclic antidepressant overdose. Although the patient is awake, protecting the airway, and exchanging gas well, intubation is advisable to guard against the strong likelihood of clinical deterioration, which can occur relatively abruptly and includes coma, seizure, cardiac dysrhythmia or arrest, and possible aspiration of activated charcoal or gastric contents.” (Walls 2009)

“The indications for tracheal intubation in the ED include correction of hypoxia or hypercarbia, prevention of impending hypoventilation, and ensuring maintenance of a patent airway.” (Tintinalli 2011 Chapter 30)

“Any clinical situation in which a definitive airway is necessary, and limited neck motion is permissible, is an indication for direct laryngoscopy. An unstabilized injured cervical spine is a relative contraindication to direct laryngoscopy, but should not preclude definitive airway management if a safer means of securing an airway is not available.” (McGill 2009)

7-Kontraindikationer

- Partial transection of the trachea (Barker 2012)

“Contraindications to RSI are relative, and primarily occur when the anticipated airway difficulties suggest that paralysis may lead to a "cannot intubate, cannot ventilate" predicament.” (Tintinalli 2011 Chapter 30)

“Historically, it was believed that oral endotracheal intubation carried an unacceptably high risk of injury to the cervical spinal cord in patients with blunt cervical spine injury and was relatively contraindicated, but this assertion was never subjected to scientific scrutiny. Numerous studies and reports have asserted the safety and effectiveness of controlled, oral intubation with in-line cervical spine immobilization, whether done as an awake procedure or with neuromuscular blockade.[95,96] The evidence favors RSI with in-line stabilization, which provides maximal control of the patient, the ability to mitigate adverse effects of the intubation, and the best conditions for laryngoscopy. In-line stabilization also seems to improve the laryngoscopic view of the larynxcompared with conventional tape/collar/sandbag immobilization.” (Walls 2009)

8-Förberedelser

“Before intubating, take the following steps in chronological order: (1) attach the necessary monitoring devices and administer oxygen; (2) establish intravenous access; (3) draw up essential medications and label them if time permits; (4) confirm that the intubation equipment is available and functioning; (5) reassess oxygenation and maximize preoxygenation; and (6) position the patient correctly. Assess for a difficult airway, which is not a discrete step but rather a process that may crystallize immediately or progress in an orderly fashion as the clinical situation evolves. In the haste of the moment, it is a common error to forget to preoxygenate or to position the patient optimally. Simple omissions, such as failing to restrain the patient's hands, remove the patient's dentures, or misplace the suction tip, can seriously hamper the success of the procedure.” (McGill 2009)

10-Preoxygenerar

“The purpose of RSI is to avoid positive-pressure ventilation until the ETT is placed correctly in the trachea with the cuff inflated. This requires a preoxygenation phase, during which the nitrogen reservoir in the functional residual capacity in the lungs is replaced with oxygen, permitting at least several minutes of apnea (see later discussion) in the normal adult before oxygen desaturation to 90% ensues.” (Walls 2009)

“Administration of 100% oxygen for 3 minutes of normal, tidal volume breathing in a normal, healthy adult establishes an adequate oxygen reservoir to permit 8 minutes of apnea before oxygen desaturation to less than 90% occurs. The time to desaturation to less than 90% in children, obese adults, late-term pregnant women, and patients with significant comorbidity is considerably less. Desaturation time also is reduced if the patient does not inspire 100% oxygen. Nevertheless, adequate preoxygenation usually can be obtained, even in ED patients, to permit several minutes of apnea before oxygen desaturation to less than 90% occurs. In children and adults, preoxygenation is essential to the “no bagging” approach of RSI. If time is insufficient for a full 3-minute preoxygenation phase, eight vital capacity breaths using high-flow oxygen can achieve oxygen saturations and apnea times that match or exceed those obtained with traditional preoxygenation. Preoxygenation of obese patients in the head up position results in significantly longer (approximately 45 seconds) apnea time before critical saturation. Preoxygenation should be done in parallel with the preparation phase and can be started in the field for high risk patients." (Walls 2009)

Barn: "Initiate preoxygenation, even if oxygen saturation is 100%." (Tintinalli 2011 Chapter 29)

Vuxna: "Begin preoxygenation as soon as intubation becomes a consideration. Preoxygenate all patients being intubated, including those with no apparent hypoxia. Preoxygenation displaces nitrogen with oxygen in the alveolar space, creating a potential reservoir of oxygen that may prevent hypoxia for several minutes of apnea. Even with adequate preoxygenation, hypoxia develops more quickly in children, pregnant women, obese patients, and in hyperdynamic states. To preoxygenate, administer 100% oxygen for 3 minutes, using a non-rebreather mask supplied with 15 L/min of oxygen. Nasal cannulas do not provide optimal preoxygenation. Non-rebreather masks typically deliver 65% to 75% oxygen. Circumstances may require preoxygenation with an appropriate bag-mask ventilator, which can deliver 90% to 97% oxygen." (Tintinalli 2011 Chapter 30)

"In cardiac arrest, it is a judgment call as to whether attempts at preoxygenation versus immediate intubation will result in less hypoxic downtime. Impossible to distinctly characterize, real time clinical conditions and available resources allow for variations based on the individual scenario and clinicians approach. Whenever possible, however, preoxygenate all patients in whom tracheal intubation is contemplated. The goal is to maximize alveolar oxygenation in order to limit the risk of hypoxia during intubation attempts. Administer high-flow oxygen, applying it as early as possible with a tight-fitting mask." (McGill 2009)

"Considerable research has been directed toward identifying the optimum method for preoxygenation. Most studies evaluating the efficacy of various preoxygenation approaches have been conducted in the setting of elective intubation. The major focus has been to identify the minimum number of deep breaths that will provide the same degree of oxygenation (denitrogenation) as 3 minutes of a normal volume of breathing of 100% oxygen, the traditional standard. The current recommendation is eight deep breathes over 60 seconds.[3] A reasonable goal is at least eight maximum breaths or 3 minutes of normal tidal volume breathing, both using high oxygen flow rates at 15 L/min. Such preoxygenation can maintain acceptable oxygen saturation for up to 8 minutes in the previously healthy apneic patient." (McGill 2009)

"The studies addressing the question of how best to preoxygenate patients were conducted under ideal conditions in relatively healthy individuals. It is far more challenging to effectively preoxygenate the critically ill.[4] The principles, nonetheless, are important to keep in mind because not all patients undergoing emergency intubation are in cardiopulmonary extremis and some may be able to follow commands. The groups at greatest risk of rapid desaturation—the obese, the pregnant, and the pediatric patient—will benefit the most. If possible, sit the obese patient up to at least 25° during preoxygenation because significantly higher oxygen tensions can be achieved in this position.[5] In addition to increasing the functional residual volume and decreasing the resistance to inspiration, elevating the head of the bed decreases the chance of aspiration. These advantages can be seen with all patients, although they are most pronounced in the obese." (McGill 2009)

11-Pulsoximeter
"All such patients require continuous cardiac monitoring and pulse oximetry." (Walls 2009)

"Oxygen saturation monitors permit earlier detection of desaturation during laryngoscopy." (Walls 2009)

12-IV-/IO infarter
"At least one and preferably two good-quality intravenous (IV) lines should be established. Redundancy is always desirable in case of equipment or IV access failure." (Walls 2009)

"Ensure reliable IV access. In cases of urgency and no IV access, an IO line may be needed." (Tintinalli 2011 Chapter 29)

13-Pågående Ringerinfusion
"a fluid bolus (20 cc/kg normal saline) is often beneficial before initiation of RSI. Many children require intubation for respiratory failure, which is often associated with dehydration from reduced oral intake and increased insensible losses. In addition, positive pressure resulting from ventilation after intubation may decrease preload, making preintubation fluid resuscitation important." (Tintialli 2011 Chapter 29)

"An IV infusion should be running properly." (McGill 2009)

14-Hjärtrytmövervakning
"All such patients require continuous cardiac monitoring" (Walls 2009)

"Pharyngeal stimulation can produce profound bradycardia or asystole, hence, the reason for *an assistant to follow the cardiac rhythm throughout the intubation*. Keep atropine available to reverse vagal-induced bradycardia that may occur secondary to suctioning or laryngoscopy." (McGill 2009)

15-Läkemedel
"Draw the necessary drugs (e.g., atropine, lidocaine, paralyzing agent, induction agent)." (McGill 2009)

"Drugs are drawn up and labeled." (Walls 2009)

"The unconscious, unresponsive, near death patient may not require pharmacologic agents for intubation. If the patient is essentially dead, administration of any pharmacologic agent, including an NMBA, may needlessly delay intubation. Even an unconscious patient may retain sufficient muscle tone to render intubation difficult, however. If the glottis is not adequately visualized, administration of a single dose of succinylcholine alone may facilitate laryngoscopy. Success rates for intubating unconscious, unresponsive patients are comparable to those achieved with RSI, presumably because the patient is in a similar physiologic state (i.e., muscle relaxation, no ability to react to laryngoscopy or tube insertion)." (Walls 2009)

16-Förbereder utrustning och team
Här menas utrustning som är specifik för ingreppet; övrig utrustning listas i sektion 1-Förbereda patienten. WHO rekommenderar en "Timeout" inför varje sövning/operation på operationssal för att minska antalet komplikationer genom bättre förberedelser och teamarbete. På akutrummet sker ofta en presentation av teamet innan patienten kommer och dess roller. Inför en känslig uppgift som intubation, bör hela teamet veta när den sker så att ingen exempelvis drar i patienten. De som assisterar den som intuberar bör också veta vad som förväntas av dem, liksom plan B – vad man

tänker göra om man inte lyckas med intubationen.

17-Skyddutrustning
"Airway management presents many opportunities for exposure to patient secretions. Wear adequate protective clothing, including a gown, gloves, mask, and either a face shield or goggles, any time the airway is manipulated. When the intubator's fingers are in the patient's mouth (eg, digital intubation, lighted stylet), care must be taken to prevent bite wounds. Place a bite block or dental prod before initiating intubation. Alternatively, place several layers of gauze between the intubator's hand and the patient's teeth. If the patient wears dentures, remove them before airway manipulation." (3)

"In addition to the preparations necessary for optimum patient care, take steps to minimize clinician exposure to potentially infectious materials in patient secretions by wearing gloves, gown, goggles, and mouth protection." (McGill 2009)

18-Laryngoskop och blad
Vuxna: "In adults, the curved Macintosh #3 is the most popular, and #4 is more useful in large patients. The straight Miller #2 or #3 is popular for the same purposes." (Tintinalli 2011 Chapter 30)

Barn: "Straight laryngoscope blades (Miller) are preferred to curved blades in young children because the large epiglottis can be lifted directly, and the large tongue is more easily displaced to provide direct visualization. A blade that is too small or short is potentially more difficult to use than one that is too large, as a short blade may not reach the supraglottic area. To determine proper blade length, place the blade handle joint at the child's upper incisors and the tip at the angle of the mandible. The length of the blade from its tip to the handle joint should be within 1 cm proximal or distal of the angle of the mandible.[6] The #0 straight (Miller) blade, or #1 curved (MacIntosh) blades are only used for the small or premature newborn." (Tintinalli 2011 Chapter 29)

"The epiglottis is high and soft, making visualization of the cords more difficult. . . . A straight laryngoscope blade is desirable to displace the floppy epiglottis, especially in young children." (Walls 2009)

"Prepare different sized blades . . . " (Tintinalli 2011 Chapter 29)

"the intubation is planned, including determining dosages and sequence of drugs, tube size, and laryngoscope type, blade and size." (Walls 2009)

"Check the laryngoscope light source. Have a second light source, a selection of blades, and additional endotracheal tubes (ETs) available." (McGill 2009) Kontrollera att ljuset fungerar i 10 sekunder.

"The straight blade is often a better choice in pediatric patients, in patients with an anterior larynx or a long floppy epiglottis, and in individuals whose larynx is fixed by scar tissue. It is less effective, however, in patients with prominent upper teeth, and it is more likely to break teeth. Use of the straight blade is also more often associated with laryngospasm owing to its stimulation of the superior laryngeal nerve, which innervates the undersurface of the epiglottis. A straight blade may inadvertently be advanced into the esophagus and initially present one with unfamiliar anatomy until it is withdrawn. The blade has a light bulb at the tip that may slightly hamper vision. The wider, curved blades are helpful in keeping the tongue retracted from the field of vision, allowing for more room in passing the tube in the oropharynx, and they are generally preferred in uncomplicated adult intubations. Aside from patient considerations, some clinicians prefer the curved blade because they find it requires less forearm strength than the straight blade." (McGill 2009)

19-Grov sug påslagen
"Turn on the oral suction device and place it so that it is immediately available near the clinician's right hand. Prepare the catheter suction for postintubation use." (McGill 2009)

"Make sure that oral and endotracheal suction catheters are functioning and of proper size." (Tintinalli 2011 Chapter 29)

"Suction should be immediately available and is critical to ensure adequate visualization during laryngoscopy and prevent aspiration during emergent intubation. The Yankauer catheter is the most common device used, but large-diameter suction systems or tubing may be required for the removal of particulate matter or large clots. The rigid-tip plastic tonsil suction catheter can remove large quantities of oropharyngeal secretions." (Tintinalli 2011 Chapter 30)

20-Tubstorlek
Vuxna: "The approximate sizes for ETTs are 8.0- to 8.5-mm inner diameter for an adult male and 7.5- to 8.0-mm inner diameter for an adult female." (Tintinalli 2011 Chapter 30) "When preparing for intubation, select the appropriate-size endotracheal tube (ETT) and an additional tube (0.5 to 1.0 mm in diameter smaller)" (Tintinalli 2011 Chapter 30)

Barn > 1 år: "The formula (16 + age in years)/4 . . . can also reasonably estimate the size, as measured by internal diameter (ID) in children >1 year of age." (Tintinalli 2011 Chapter 29)

"For most clinical situations, however, using the width of the nail of the little (fifth) finger as a guide is sufficiently accurate and has been shown to be more precise than finger diameter." (McGill 2009)

"Prepare . . . at least one size smaller endotracheal tube." (Tintinalli 2011 Chapter 29)

"Endotracheal tubes below 5.5 mm ID are traditionally recommended to be uncuffed. This is because the cricoid ring represents the narrowest point of a pediatric airway and serves as a physiologic cuff. More recent data suggest that the use of cuffed tubes in younger children is safe, however cuff inflation pressures must be closely monitored" (Tintinalli 2011 Chapter 29)

"Adult men generally accept a 7.5- to 9.0-mm orotracheal tube, whereas women can usually be intubated with a 7.0- to 8.0-mm tube. Larger tubes are theoretically desirable because airway resistance increases as tube size decreases, however, in practice, a 7.5-mm tube is adequate for almost all patients. In emergency intubations, particularly if a difficult intubation is anticipated, many clinicians choose a smaller tube and change to a larger tube later if necessary. Although generally an acceptable practice, this should be avoided in the burn patient because swelling may prohibit subsequent tube placement." (McGill 2009)

"Correct tube size is important in the pediatric population. It is especially important when using an uncuffed tube because a good seal is needed between the ET tube and the upper trachea. Because tube size is based on the ID, a cuffed tube should generally be one half size (0.5 mm) smaller than an uncuffed tube. The smaller ID of an appropriately sized, small, cuffed tube could theoretically make it more prone to plugging from secretions. Cuffed tubes are available down to a 3-mm ID, although indications for these tubes in neonates and infants are rare. A cuffed tube is used in children with decreased lung compliance who may require prolonged mechanical ventilation. In a child, the smallest airway diameter is at the cricoid ring rather than at the vocal cords, as in adults. Hence, a tube may pass the cords but go no farther. If this should occur, the next smaller sized tube should be passed." (McGill 2009)

21-Kontrollerar kuffen
"check the cuffs for air leaks with a 10-mL syringe." (Tintinalli 2011 Chapter 30)

"Check the integrity of the balloon and cuff on the tracheal tube." (McGill 2009)

"Place the syringe to inflate the ET balloon on the stretcher to the right of the patient's head. An option is to attach a syringe to the pilot balloon of the ET tube." (McGill 2009)

"Check the ET tube cuff for leaks by inflating the pilot balloon before attempting intubation." (McGill 2009)

22-Ledare
"A stylet should be inserted properly into the tracheal tube." (McGill 2009)

"Prepare the tube for placement by passing a flexible stylet down the tube to increase its stiffness and enhance control of the tip of the tube. Do not extend the stylet beyond the eyelet of the tube. Bend the tube in a gradual curve with a more acute angling in the distal third to more easily access the anterior larynx." (McGill 2009)

23-Rubens blåsa & mask
"Attach the bag-valve-mask to an oxygen source (rate of 15 L/min)." (McGill 2009) Se dokument Ventilation med mask och blåsa gällande mask storlek.

24-Svalgtub
Det finns två anledningar att ha en svalgtub i beredskap:

- Vid lyckad intubation rekommenderas en svalgtub för att skydda endotrakealtuben: "A bite block or oral airway to prevent ET tube crimping or damage from biting is commonly incorporated into the system used to secure the tube." (McGill 2009)
- Vid misslyckad intubation underlättar en svalgtub ventilation med mask och blåsa (se dokument)

25-Tejp eller motsvarande för att säkra tuben[x]
"Have tape, twill tape, or a commercial tube stabilizer available." (McGill 2009)

26-Bedömer svårighetsgrad
"Practitioners of RSI should be adept with prediction and management of difficult airways in nonfasting patients and the use of rescue airways." (Tintinalli 2011 Chapter 30)

"Before any attempt at airway management, assess potential difficulties for BVM ventilation and intubation." (Tintinalli 2011 Chapter 30)

"In the initial phase, the patient is assessed for intubation difficulty." (Walls 2009)

“Multiple external features associated with difficult intubation include facial hair, obesity, a short neck, small or large chin, buckteeth, high arched palate, and any airway deformity due to trauma, tumor, or inflammation. Most studies of airway difficulty use a grading system identified through laryngoscopic view. Such methods are not practical in the ED. A simple, systematic, and rapid evaluation of the airway is needed to predict a potentially poor laryngoscopic view before the initiation of neuromuscular blockade. Clinical examination of the airway anatomy can identify additional difficult airway predictors. The mandibular opening in an adult should be at least 4 cm, or two to three fingerbreadths. The ability of the mandible to accommodate the tongue can be estimated by the distance between the mentum and the hyoid bone, which should be three to four fingerbreadths. A small mandible is more likely to have a tongue that obstructs visualization during laryngoscopy. An unusually large mandible also may impairvisualization by elongating the oral axis, referred to above in Patient Positioning. A high, anterior larynx is possible if the space between the mandible and top of the thyroid cartilage is narrower than two fingerbreadths. The degree to which the tongue obstructs the visualization of the posterior pharynx on mouth opening has some correlation with the visualization of the glottis. This correlation can be assessed with Mallampati criteria, with Classes III and IV being associated with poor visualization and higher failure rates (up to 5% and 20%, respectively” (Tintinalli 2011 Chapter 30)

“Neck immobility also interferes with the ability to align the visual axes by preventing the desired "sniffing position." Neck immobility may be imposed by the presence of a cervical collar. If there is no suspicion of cervical injury, atlanto-occipital extension should be assessed, even in the uncooperative patient.” (Tintinalli 2011 Chapter 30)

3-3-2 regel: “incisor distance <3 fingerbreadths, hyoid/mental distance <3 fingerbreadths, or thyroid-to-mouth distance <2 fingerbreadths indicates a potentially difficult airway.” (Reed 2005)

Rosen’s (Walls 2009) rekommenderar användning av minneshjälpen LEMON© där:

- L står för Look externally: “The patient first should be examined for external markers of difficult intubation, which are determined based simply on the intubator's clinical impression. For example, the severely bruised and bloodied face of a combative trauma patient, immobilized in a cervical collar on a spine board, might (correctly) invoke an immediate appreciation of anticipated difficult intubation.” (Walls 2009)

- E står för Evaluate 3-3-2: “The second step in the evaluation of the difficult airway is to assess the patient's anatomy to determine his or her suitability for direct laryngoscopy. Direct laryngoscopy requires the ability to visualize the glottis by direct vision through the mouth, using alignment of the oral, pharyngeal, and laryngeal axes. Visualization requires that the mouth open adequately, that the submandibular space be adequate to accommodate the tongue, and that the larynx be positioned low enough in the neck to be accessible. These relationships have been explored in various studies by external measurement of mouth opening, oropharyngeal size, neck movement, and thyromental distance. The “3-3-2 rule” is an effective summary of these geometric evaluations. The 3-3-2 rule requires that the patient be able to place 3 of his or her own fingers between the open incisors, 3 of his or her own fingers along the floor of the mandible beginning at the mentum, and 2 fingers from the laryngeal prominence to the floor of the mandible. A patient with a receding mandible and high-riding larynx can be impossible to intubate using direct laryngoscopy. Most patients are not sufficiently cooperative for such an evaluation, and the operator compares his or her fingers with the patient's fingers to estimate the sizes for the three tests." (Walls 2009)

- M står för Mallampati Scale: "Oral access is assessed using the Mallampati scale. Visibility of the oral pharynx ranges from complete visualization, including the tonsillar pillars (class I), to no visualization at all, with the tongue pressed against the hard palate (class IV). Class I and class II predict adequate oral access, class III predicts moderate difficulty, and class IV predicts a high degree of difficulty.[22,23] A recent meta-analysis confirmed that the four-class Mallampati score performs well as a predictor of difficult laryngoscopy (and, less so, difficult intubation), but that the Mallampati score, alone, is not a sufficient assessment tool." (Walls 2009)

- O står för Obstruction or Obesity: "Upper airway (supraglottic) obstruction may make visualization of the glottis, or intubation itself, mechanically impossible. Conditions such as epiglottitis, laryngeal tumor, Ludwig's angina, neck hematoma, or glottic polyps can compromise laryngoscopy, passage of the endotracheal tube (ETT), BMV, or all three. Physical examination for airway obstruction is combined with assessment of the patient's voice to satisfy this evaluation step. There is conflicting evidence regarding whether obesity is itself an independent marker of difficult intubation or whether patients with obesity simply are more likely to have other markers of difficult intubation. Regardless, obese patients generally are more difficult to intubate than their non-obese counterparts, and preparations must account both for this, and for the more rapid oxyhemoglobin desaturation and increased difficulty with ventilation using bag and mask or an EGD (see below) that will occur." (Walls 2009)

- N står för Neck Mobility: "Neck mobility is essential for the repositioning of the angled axes of the upper airway in order to permit direct visualization of the glottis. Neck mobility is assessed by having the patient flex and extend the head and neck through a full range of motion. Neck extension is the most important motion, and simple extension may be as effective as the "sniffing" position in achieving an optimal laryngeal view. A recent study also found that the "extension-extension" position, in which the neck is extended on the body (opposite of the sniffing position) with the head extended on the neck, provides superior laryngeal views to the sniffing position. Modest limitations of motion do not seriously impair laryngoscopy, but severe loss of motion, as can occur in ankylosing spondylitis or rheumatoid arthritis, for example, may render laryngoscopy impossible. Cervical spine immobilization in trauma artificially reduces cervical spine mobility and predicts a more difficult laryngoscopy, but direct laryngoscopy is still highly successful in this group of patients." (Walls 2009)

"A difficult airway as defined by the American Society of Anesthesiologists is difficulty with bag-mask ventilation, difficulty with tracheal intubation, or both.[16] Other characteristics of the difficult airway include (1) more than two attempts at intubation with the same laryngoscopic blade, (2) need for a change in blade or use of intubation stylet, and (3) need for an alternative intubation technique or rescue." (Tintinalli 2011 Chapter 29)

"A failed airway is defined as three unsuccessful attempts at intubation by an experienced operator or failure to maintain oxygenation." (Tintinalli 2011 Chapter 30)

"The emergency nature of the patient's presentation often precludes postponement of the intubation, even for a short time, but knowledge of the difficulties presented by the patient's airway permits thoughtful planning and preparation for possible intubation failure. Preintubation assessment should evaluate the patient for difficult intubation, difficult BMV, difficult ventilation using an extraglottic device (EGD, such as a laryngeal mask airway, see later discussion) and difficult cricothyrotomy. Knowledge of all four domains is crucial to successful planning." (Walls 2009)

"The classic predictors of a difficult intubation include a history of previous difficult intubation, prominent upper incisors, limited ability to extend at the atlanto-occipital joint,[7] poor visibility of pharyngeal structures when the patient extends the tongue (Mallampati classification, or the tongue/pharyngeal ratio) (Fig. 4–3*A*),[8] limited ability to open the mouth (suggested by a space < 3 fingerbreadths between upper and lower incisors),[9] a short distance from the thyroid notch to the chin with the neck in extension (see Fig. 4–3*B*),[10] and a limited direct laryngoscopic view of the laryngeal inlet (Fig. 4–4).[9] In emergency airway management, many of these predictors are not obtainable.[11] An extensive history is rarely available, the patients are frequently uncooperative, and the presence of trauma limits movement of the neck. Fortunately, some of the key predictors are apparent simply by observing the external appearance of the patient's head and neck.

Patients with neck tumors, thermal or chemical burns, traumatic injuries to the face and anterior neck, angioedema, infection of the pharyngeal and laryngeal soft tissues, or previous operations in or around the airway suggest a difficult intubation because distorted anatomy or secretions may compromise visualization of the vocal cords. Facial or skull fractures may further limit airway options by precluding nasotracheal (NT) intubation. Patients with ankylosing arthritis or developmental abnormalities, such as a hypoplastic mandible or the large tongue of Down syndrome, are difficult to intubate because neck rigidity and problems of tongue displacement can obscure visualization of the glottis.

Besides these obvious congenital and pathologic conditions, the patient with a short, thick neck is one of the more common presentations of a difficult airway. These individuals are easily identifiable by observing the head and neck in profile. Obesity alone may not be an independent predictor of difficult intubation, but obese patients with large circumference necks are likely to be difficult.[12] Facial hair can complicate a difficult airway by rendering bag-mask ventilation ineffective owing to the lack of a good seal. One patient type that does not immediately stand out as a difficult intubation, but can be surprisingly so, is the patient with an unusually long mandibulohyoid distance (the thyroid prominence appearing low in the neck) and a short mandibular ramus.[13] Visualization of the larynx, due to the distance to the larynx and the relative hypopharyngeal location of the tongue, is difficult.

When faced with an anticipated difficult airway, consider all options, including awake intubation and NT intubation. As opposed to elective operating room cases, however, "canceling the case" is rarely an option. Identification of a potentially difficult airway does not necessarily preclude direct laryngoscopy. It does, however, mandate that backup devices be at the bedside if the patient cannot be readily intubated with the laryngoscope.

It should be emphasized that some patients, despite normal-appearing anatomy and the absence of a complicating history, are unexpectedly difficult to intubate. Be prepared for this rare but inevitable occurrence." (McGill 2009)

27-Utrustning för Plan B
"Although RSI-facilitated endotracheal intubation is the foundation of emergency airway management, providers must anticipate airway difficulties and be facile with alternative airway

techniques, bag-mask ventilation, rescue airway devices, and surgical airways." (Tintinalli 2011 Chapter 30)

"Once the potential for difficulty is identified, management will vary with not only the type of airway difficulty but also the operator's experience and availability of alternative devices." (Tintinalli 2011 Chapter 30)

"Alternative or rescue devices: laryngeal mask airway, intubating laryngeal mask airway, Combitube . . . Surgical rescue equipment—surgical cricothyroidotomy kit." (Tintinalli 2011 Chapter 30)

28-Eventuella läkemedel
Läkemedel vid RSI kan kategoriseras som

- premedicinering (t ex Fentanyl)
- sedering (t ex Propofol, Ketamin)
- paralys (t ex Succinylcholine)

"The unconscious, unresponsive, near death patient may not require pharmacologic agents for intubation. If the patient is essentially dead, administration of any pharmacologic agent, including an NMBA, may needlessly delay intubation. Even an unconscious patient may retain sufficient muscle tone to render intubation difficult, however. If the glottis is not adequately visualized, administration of a single dose of succinylcholine alone may facilitate laryngoscopy. Success rates for intubating unconscious, unresponsive patients are comparable to those achieved with RSI, presumably because the patient is in a similar physiologic state (i.e., muscle relaxation, no ability to react to laryngoscopy or tube insertion)." (Walls 2009)

29-Borttagning av eventuell tandprotes, rensugning vid behov
"Remove dentures and any obscuring blood, secretions, or vomitus suctioned before insertion of the ETT." (Tintinalli 2011 Chapter 30)

"Remove the patient's dentures (delay this action until immediately before intubation if the patient is being bag-mask ventilated)" (McGill 2009)

30-Huvudposition vuxna, ej trauma
"The patient should be positioned for intubation as consciousness is lost." (Walls 2009)

"Neck extension is the most important motion, and simple extension may be as effective as the "sniffing" position in achieving an optimal laryngeal view. A recent study also found that the "extension-extension" position, in which the neck is extended on the body (opposite of the sniffing position) with the head extended on the neck, provides superior laryngeal views to the sniffing position." (Walls 2009)

"Flexion of the lower neck with extension at the atlanto-occipital joint (sniffing position) aligns the oropharyngeal-laryngeal axis, allowing a direct view of the larynx." (Tintinalli 2011 Chapter 30)

"Check for optimal head positioning: neck slightly flexed and head extended on the neck (conditions permitting). May be facilitated by placing a towel under the patient's occiput to raise it 10 cm. Obese patients usually require significantly more occiput elevation." (McGill 2009)

“Position the patient to optimally align the oral, pharyngeal, and laryngeal axes (Fig. 4–7). The desired position was aptly described by Magill to make the patient appear to be “sniffing the morning air,” with the head extended on the neck and the neck slightly flexed relative to the torso. Place a small towel under the occiput (to raise it 7–10 cm) to facilitate positioning in the average adult, but not in a child. Make a slight adjustment to the head position by placing the right hand under the patient's head, during laryngoscopy, and adjusting the extension to optimize glottic visualization (Fig. 4–8). Positioning of the head and neck is a critical step in preparation for intubation; suboptimal head positioning is a common reason for intubation difficulties.” (McGill 2009)

“Positioning of the morbidly obese patient is unique because, when the patient is supine, the neck, relative to the torso, is significantly posterior. Hence, achieving the sniffing position in these patients requires more elevation of the head and neck as well as the upper back. One method for achieving the sniffing positioning in the morbidly obese patient is to build a ramp of towels and pillows under the upper torso, head, and neck.” (McGill 2009)

31-Huvudposition barn

“If the child is very small, the prominent occiput brings the mouth to a position far anterior to the larynx; an assistant can lift the chest gently by grasping both shoulders, immobilizing the head at the same time.” (Walls 2009)

Endotracheal intubation in children: “Proper positioning is critical, and optimal alignment of the airway axes for laryngoscopy is the same as described in the previous section for bag-mask ventilation.” (Tintinalli 2011 Chapter 29)

“Infants' proportionately larger heads naturally place them in the sniffing position, so a towel under the occiput is rarely necessary. The large head can even result in a posterior positioning of the larynx that prevents visualization of the vocal cords; a small towel under the child's shoulders should correct this problem. The head may also be floppy and may benefit from stabilization by an assistant.” (McGill 2009)

32-Huvudposition, trauma

“all trauma patients with potential cervical spine injury should be intubated while maintaining inline manual spine immobilization as best as possible and minimizing spine movement or distraction.” (Tintinalli 2011 Chapter 30)

“Historically, it was believed that oral endotracheal intubation carried an unacceptably high risk of injury to the cervical spinal cord in patients with blunt cervical spine injury and was relatively contraindicated, but this assertion was never subjected to scientific scrutiny. Numerous studies and reports have asserted the safety and effectiveness of controlled, oral intubation with in-line cervical spine immobilization, whether done as an awake procedure or with neuromuscular blockade.[95,96] The evidence favors RSI with in-line stabilization, which provides maximal control of the patient, the ability to mitigate adverse effects of the intubation, and the best conditions for laryngoscopy. In-line stabilization also seems to improve the laryngoscopic view of the larynxcompared with conventional tape/collar/sandbag immobilization.” (Walls 2009)

“There are ongoing concerns that direct laryngoscopy may cause or worsen cord injury in the patient with an unstable cervical spine injury. *The actual effects of laryngoscopy and oral intubation on worsening of extant cervical spinal cord injury are essentially theoretical, with no* *credible data to prove, or disprove, a true effect, or magnitude thereof*. Many anesthesiologists prefer awake fiberoptic intubation in this setting but there are no data to support one approach over another. A cadaveric study of intubation under fluoroscopy showed that direct laryngoscopy with inline immobilization, in the setting of complete C4–5 ligamentous instability, did not result in clinically significant instability.[62] The greatest degree of motion, however, occurs at the atlanto-occipital junction and decreases with each sequential interspace; studies of cervical spine instability at these higher levels have not been performed.[63] It can also be argued that cadaveric studies do not accurately depict the trauma setting, and yet this model is probably going to remain the best one available. Unless new information emerges regarding the risks of orotracheal intubation with direct laryngoscopy, *this appears to be a safe approach when performed in conjunction with in-line immobilization." (McGill 2009)*

33-Layngoskopet förs till höger om tungan
"Insert blade into the right corner of the patient's mouth. The flange of the curved Macintosh blade will push the tongue toward the left side of the oropharynx. If the blade is inserted directly down the middle, the tongue can force the line of sight posteriorly, which is a common reason for the putative "anterior larynx."" (Tintinalli 2011 Chapter 30)

"Grasp the laryngoscope in the left hand with the blade directed toward the patient from the hypothenar aspect of your hand. Draw down the patient's lower lip with your right thumb, and introduce the tip of the laryngoscope into the right side of the patient's mouth. Slide the blade along the right side of the tongue, gradually displacing the tongue toward the left as you move the blade to the center of the mouth. If you initially place the blade in the middle of the tongue, it will fold over the lateral edge of the blade and obscure the airway. Placing the blade in the middle of the tongue and failing to move the tongue to the left are two common errors preventing visualization of the vocal cords." (McGill 2009)

34-Lyfter i laryngoskophandtagets riktning (45 grader)
"As you move the blade tip toward the base of the tongue, exert a force along the axis of the laryngoscope handle, lifting upward and forward at a 45° angle (see Fig. 4–8). The direction of this force is critical because if the force is too horizontal or too vertical it will result in poor visualization. The epiglottis should come into view with this maneuver. It may help to have an assistant retract the cheek laterally to further expose the laryngeal structures. Avoid bending the wrist because it can result in dental injury if the teeth become a fulcrum for the blade." (McGill 2009)

35-För in eller backar laryngoskopbladet
Barn: "If using a straight blade, the large epiglottis overlies the vocal cords. Pick up the epiglottis with the straight blade to see the cords below. In younger children, there is a tendency to place the blade too deeply, into the esophagus. If identification of structures is impossible, the tip of the blade is usually in the upper esophagus, or retroglottic space. Slowly withdraw the blade, and the cords or the epiglottis should come into view." (Tintinalli 2011 Chapter 29)

Vuxna: "Advance blade incrementally. Look for the arytenoid cartilages to avoid overly deep insertion of the blade, which is a common error." (Tintinalli 2011 Chapter 30)

"The step after visualization of the epiglottis depends on which laryngoscope blade is used. With the curved blade, place the tip into the vallecula, the space between the base of the tongue and the epiglottis. Continued anterior elevation of the base of the tongue and the epiglottis will expose the vocal cords. If the blade tip is inserted too deeply into the vallecula, the epiglottis may be pushed down to obscure the glottis.[8] When using the straight blade, insert the tip under and slightly beyond the epiglottis, directly lifting it up. If the straight blade is placed too deeply, the entire larynx may be elevated anteriorly and out of the field of vision. Gradually withdraw the blade to allow the laryngeal inlet to drop down into view. If the blade is deep and posterior, the lack of recognizable structures indicates esophageal passage; gradually withdraw to permit the laryngeal inlet to come into view." (McGill 2009)

36-Visualiseringsmanövrar
"The larynx is higher in the child's neck, causing a more acute angle between the oral pharynx and the larynx. Visualization is aided by gentle posterior pressure on the anterior aspect of the thyroid cartilage." (Walls 2009)

Barn: "Visualization may or may not be enhanced by use of backward-upward-rightward pressure on the thyroid cartilage (the "BURP" maneuver), displacing the cords to the right and posterior into better view." (Tintinalli 2011 Chapter 29)

Vuxna: "The application of backward-upward-rightward pressure on the thyroid cartilage is commonly used to enhance visualization of the anterior glottis. However, bimanual laryngoscopy, a technique in which the intubator manipulates the larynx with the right hand until ideal visualization, and then an assistant maintains this position, provides better visualization of the vocal cords." (Tintinalli 2011 Chapter 30)

"Backward pressure on the thyroid cartilage, combined with cephalad pressure and displacement to the right pressure, improves visualization during direct laryngoscopy. The technique was first reported in 1993.[29] A comparison of BURP with simple Back technique in the operating room showed that both maneuvers improved visualization, although the BURP technique was significantly more effective." (McGill 2009)

"Grasp the lower portion of the thyroid cartilage with the thumb on one side and the index and middle fingers on the other (see Fig. 4–10*B*). Apply pressure in the backward direction and press the larynx against the vertebrae. With continued backward pressure, shift the larynx in an upward direction as far as possible. Exert additional pressure to shift the larynx to the patient's right. The rightward shift in an adult should be no more than 2 cm, because greater displacement has been shown to worsen the laryngoscopic view." (McGill 2009)

The bimanual laryngoscopy technique, also called OELM (optimal-external-laryngeal-manipulation): "Hold the laryngoscope in the left hand while manipulating the larynx with the right. Hold the larynx by placing the thumb, index, and middle fingers of the right hand on the hyoid bone, thyroid cartilage, and cricoid cartilage (see Fig. 4–10*C*). Use the pressure of the right hand to displace the larynx posteriorly and to the right until an optimum laryngeal view is obtained with the laryngoscope. Either direction, posterior or to the right, or both, may produce an optimum view. The position of the clinician's right hand is then assumed by an assistant as the clinician intubates the patient." (McGill 2009)

37-Tubinförande
"ETT must be visualized until the cuff has passed through vocal cords." (Tintinalli 2011 Chapter 30)

“Once the vocal cords have been visualized, the final step is to pass the tube under direct vision through the vocal cords and into the trachea. Hold the tube in your right hand and introduce it from the right side of the patient's mouth. *Distraction of the cheek may greatly aid overall visualization.* Advance the tube toward the patient's larynx at an angle, not parallel with or down the slot of the laryngoscope blade. This way, the tube does not obstruct the view of the larynx until the last possible moment before the tube enters the larynx. If the patient is not chemically paralyzed, pass the tube during inspiration, when the vocal cords are maximally open. It enters the trachea when the cuff disappears through the vocal cords. Advance the tube 3 to 4 cm beyond this point. It is not enough to see the tube and the cords; watch the tube pass through the vocal cords to ensure tracheal placement. *Directly observing the tube pass through the cords is the “gold standard” to confirm correct placement.” (McGill 2009)*

“To avoid error, make sure you see the cuff of the ETT pass completely through the cords. Abort the attempt if visualization of the larynx is not successful. (Tintinalli 2011 Chapter 30)

“Never force the tube through the vocal cords. Forcing the tube can avulse the arytenoid cartilages or lacerate the vocal cords. Difficulty in passing the tube through the glottic opening usually reflects a failure to maintain the best possible laryngoscopic view throughout the procedure. A maneuver that may overcome glottic resistance is gentle 90-degree clockwise or counterclockwise rotation of the ETT. This may provide a more favorable alignment of the bevel of the ETT with the glottic opening.” (Tintinalli 2011 Chapter 30)

38-Dokumenterar avstånd tubspets-framtänder

“Estimate the proper depth of tube placement, before radiograph confirmation, using the following formulas, in which the *length represents the distance from the tube tip to the upper incisors in children36,37 [36] [37] and from the upper incisors 38 or the corner of the mouth 39 in adults*:

Children: Tracheal tube depth (cm) = age (yr)/2 + 12

Adults: Tracheal tube depth (cm) = 21 cm (women) Tracheal tube depth (cm) = 23 cm (men).

In adults, this method has been shown to be more reliable than auscultation in determining the correct depth of placement.[38] One can anticipate, however, that tall male patients will often require deeper placement, to 24 or 25 cm, and short women will often require a shallower placement of 19 or 20 cm.” (McGill 2009)

“Persistent, obvious leak despite positive ETCO2 detection indicates cuff malfunction or supraglottic placement of the ETT, such that the tube is in the airway, detecting CO2, but above the vocal cords. In either case (main stem bronchus intubation or supraglottic intubation), tube malpositioning can be confirmed by inspection of the depth of insertion of the tube, supplemented by chest radiography when needed.” (Walls 2009)

Barn: “There is a tendency to insert the endotracheal tube too far in the very young child, in whom the distance from laryngeal cords to tracheal carina may just be a few centimeters. Right mainstem intubation is not always appreciated on auscultation, particularly in the infant as breath sounds may be transmitted throughout the chest. Therefore, predetermine endotracheal tube depth and adhere to that depth during intubation. Depth can be estimated by **Formula 29-2** [tube ID x 3 = depth at the lips]. For example, a 4.0 mm ID tube should be 12 cm at the lips.” (Tintinalli 2011 Chapter 29)

39-Kuffen

“Inflate balloon Use 5 cc of air.” (Tintinalli 2011 Chapter 30)

“To avoid ischemia of the tracheal mucosa, cuff pressure should be kept below 40 cm. The cuff is inflated with 5 cc of air. There is poor correlation between volume of air and tracheal cuff pressure,[5] and if there is concern about cuff pressure, a manometer can be used to measure cuff pressure [cuff pressures should be between 25 and 30 cm of water (cm H_2O)]; however, this is not routinely performed in the ED setting.” (Tintinalli 2011 Chapter 30)

“Inflate the cuff to the point of minimal air leak with positive-pressure ventilation. In an emergency intubation, place 10 mL of air, and adjust inflation volume after the patient is stabilized.” (McGill 2009)

40-Avbryter misslyckat intubationsförsök
Läkaren bör avbryta misslyckade intubationsförsök och tillgodose adekvat ventilation med antingen konservativa åtgärder (basala luftvägsmanöver och ventilation med mask och blåsa), laynxmask eller coniotomi. Att inte avbryta intubationsförsök i tid kan leda till hypoxi med irreversibel hjärnskada (se ”Just a routine operation” som exempel).

“As a guide, limit intubation attempts to the amount of time a single deep breath can be held. This is especially important in a child because the functional residual capacity of a child's lungs is less than that of an adult. Historically, the maximum recommended duration of an intubation attempt in an apneic patient has been 30 seconds, followed by a period of bag-valve-mask ventilation before intubation is attempted again. Longer intubation attempts are permissible, however, when guided by accurate data from an oxygen saturation monitor. Oxygen saturation may remain in the normal range for minutes, especially in patients who have been adequately preoxygenated. Assuming that preintubation oxygen saturations were acceptable at greater than 98%, intubation attempts should be interrupted for bag-mask ventilation if O_2 saturation drops below 92%.” (McGill 2009)

41-Cricoidtryck
“When BMV is performed, Sellick's maneuver is advisable to minimize passage of air into the stomach.[41] Sellick's maneuver may be continued or released during repeat laryngoscopy, according to the judgment of the clinician and the glottic view obtained.” (Walls 2009)

42-Ventilation med mask och blåsa
“The ETT is placed under direct visualization of the glottis. If the first attempt is unsuccessful, but oxygen saturation remains high, it is not necessary to ventilate the patient with a bag and mask between intubation attempts. If the oxygen saturation is approaching 90%, the patient may be ventilated briefly with a bag and mask between attempts to reestablish the oxygen reservoir.” (Walls 2009)

43-Auskulterar
“After tracheal tube placement, auscultate both lungs under positive-pressure ventilation. Take care to auscultate posterolaterally because auscultation anteriorly can reveal sounds that mimic breath sounds but arise from the stomach.” (McGill 2009)

“The examiner should auscultate both lung fields and the epigastric area. Auscultation of typical hollow, gurgling, gastric sounds in the epigastrium is highly suggestive of esophageal intubation and should prompt consideration of immediate reintubation. Diminished or absent breath sounds on one side (usually the left side) indicate main stem bronchus intubation, in the absence of pneumothorax or an alternative cause of unilateral loss of breath sounds.” (Walls 2009)

“The most serious complication of endotracheal intubation is unrecognized esophageal intubation with resultant hypoxic brain injury. Although direct visualization of the ETT passing through the vocal cords generally is a reliable indicator of tracheal intubation, such clinical anatomic observations are fallible, and additional means are required to ensure correct placement of the tube within the trachea. Traditional methods, such as chest auscultation, gastric auscultation, bag resistance, exhaled volume, visualization of condensation within the ETT, and chest radiography, all are prone to failure as means of confirming tracheal intubation.” (Walls 2009)

Vuxna: “There is no clinically reliable substitute for directly visualizing the tube passing through the vocal cords. Clinical assessments, including chest and epigastric auscultation, tube condensation, and symmetric chest wall expansion, are not infallible. "Breath sounds" from the stomach can be transmitted through the chest after gastric insufflation.” (Tintinalli 2011 Chapter 30)

Barn: “Visualization of the tube through the cords or fogging of the tube is not adequate confirmation of tube placement in the trachea.” (Tintinalli 2011 Chapter 29)

44-Kapnometri eller kapnografi
“ET_{CO2} detection, with aspiration as backup, should be considered the primary means of ETT placement confirmation.” (Walls 2009)

“Immediately after intubation, the intubator should apply an end-tidal carbon dioxide (ET_{CO2}) detection device to the ETT and assess it through six manual ventilations. Disposable, colorimetric ET_{CO2} detectors are highly reliable, convenient, and easy to interpret, indicating adequate CO_2 detection by color change (Figs. 1-3 and 1-4) (see Chapter 3). ET_{CO2} detection is highly reliable in determining tracheal and esophageal intubation in patients with spontaneous circulation.[33] These devices indicate the carbon dioxide content in exhaled air either qualitatively or quantitatively. The persistence of detected CO_2 after six manual breaths indicates that the tube is within the airway, although not necessarily within the trachea. Gas exchange is detected with the tube in the mainstem bronchus, the trachea, or the supraglottic space. Correlation of ET_{CO2} detection with the depth markings on the endotracheal tube (particularly important in pediatric patients) confirms tracheal placement. Rarely, BMV before intubation or ingestion of carbonated beverages may lead to release of CO_2 from the stomach after esophageal intubation, causing a transient false indication of tracheal intubation. Washout of this phenomenon occurs within six breaths, however, so persistence of CO_2 detection after six breaths indicates tracheal intubation.” (Walls 2009)

Barn: “Immediately after intubation, confirm endotracheal tube placement using a capnograph or a colorimetric end-tidal CO2 detector. A small-sized colorimetric end-tidal CO2 detector should be used for children weighing <15 kg. For larger children, weighing >15 kg, use the adult sized CO2 detector, as there can be a resistance to flow when using the smaller device with larger tidal volumes.” (Tintinalli 2011 Chapter 29)

“A multicenter study of a colorimetric device demonstrated an overall sensitivity of 80% and a specificity of 96%.[50] In patients with spontaneous circulation and the tracheal tube cuff inflated, the sensitivity and specificity were 100%. The poor sensitivity (69%) seen in cardiac arrest was due to the fact that low exhaled CO_2 levels were seen in both very-low-flow states and esophageal intubation. The device must, therefore, be used with caution in the cardiac arrest victim. Levels of CO_2 returned to normal after return of spontaneous circulation. Further, colorimetric changes may be difficult to discern in reduced lighting situations, and secretions can interfere with the color change. Regardless of the monitoring device, patients in cardiac arrest should be ventilated for a minimum of six breaths before taking a reading. Otherwise, recent ingestion of carbonated beverages can result in spuriously high CO_2 levels with esophageal intubation.[51] Colorimetric changes do not rule out glottic positioning of the ET tube tip. Adequate ventilation and oxygenation may be achieved in the glottic position, but the risk remains for aspiration in the absence of a protected airway and the potential for further tube dislodgment." (McGill 2009)

45-Svalgtub / bitblock
"A bite block or oral airway to prevent ET tube crimping or damage from biting is commonly incorporated into the system used to secure the tube." (McGill 2009)

46-Fixerar tuben
"With the tube in position and the cuff inflated, secure the tube in place. Attach commercial ET tube holders, adhesive tape, or umbilical (nonadhesive cloth) tape securely to the tube and around the patient's head (Figs. 4–14 and 4–15). Position the tube at the corner of the mouth, where the tongue cannot expel it. This position is also more comfortable for the patient and allows for suctioning." (McGill 2009)

Barn: "Carefully secure the tube at the mouth, using either tape adhered to the maxilla with skin adhesive or available commercial devices. Because of the short distance between the glottic opening and the end of the endotracheal tube, infants are prone to displacement of the tube, into the oral pharynx with head extension, and into the right mainstem bronchus with head flexion. Immobilize the head and neck in a neutral position in intubated young children." (Tintinalli 2011 Chapter 29)

"Secure the ETT but do not impede cervical venous return. Do not kink the pilot tube." (Tintinalli 2011 Chapter 30)

47-Rensuger i tuben
"Repeated suctioning helps prevent thrombotic or inspissated secretions from obstructing the tube or bronchus and causing ball-valve effect." (Tintinalli 2011 Chapter 30)

48-Fortsatt sedering, ventilation och monitorering
"Provide adequate sedation and analgesia before the effects of induction and paralysis agents wear off. This is particularly important when rocuronium or other longer-acting muscle relaxants are used, as their duration is often much longer than most induction agents used in RSI." (Tintinalli 2011 Chapter 29)

"Provide postintubation sedation and postintubation management." (Tintinalli 2011 Chapter 30)

"After intubation, prolonged paralysis may be desired to optimize mechanical ventilation; however, current management trends are away from the use of prolonged paralysis in favor of deep sedation with analgesia. If neuromuscular blockade is desired, vecuronium (0.1 mg/kg IV) can be given. Longer term neuromuscular blockade must not be undertaken without attention to appropriate sedation and analgesia of the patient.[50] An adequate dose of a benzodiazepine, such as midazolam (0.1–0.2 mg/kg IV), and an opioid analgesic, such as fentanyl (3–5 ug/kg IV) or morphine (0.2–0.3 mg/kg IV), is required to improve patient comfort and decrease sympathetic response to the ETT. Appropriate use of sedation and analgesia often obviates the need for an NMBA. Additional medication may be required if the patient's blood pressure and heart rate indicate excessive sympathetic tone." (Walls 2009)

49-Röntgen
"Although chest radiography is universally recommended after ETT placement, its primary purpose is to ensure that the tube is well positioned below the cords and above the carina. A single anteroposterior chest radiograph is not sufficient to detect esophageal intubation, although esophageal intubation may be detected if the ETT is clearly outside the air shadow of the trachea." (Walls 2009)

"A chest radiograph should be obtained to confirm that main stem intubation has not occurred and to assess the lungs." (Walls 2009)

Barn: "equal breath sounds do not preclude right mainstem bronchus intubation, and a chest x-ray should be obtained shortly after intubation to confirm appropriate depth." (Tintinalli 2011 Chapter 29)

Vuxna: "Correct tube placement is a minimum of 2 cm above the carina." (Tintinalli 2011 Chapter 30)

"After intubation, a chest x-ray is used to identify mainstem bronchus intubation or to locate the ETT tip. A chest x-ray does not distinguish ETT placement in the trachea from the esophagus. Ultrasound and transthoracic impedance are being explored as possible methods of objective tube placement confirmation, but their role is still evolving." (Tintinalli 2011 Chapter 30)

"Although seldom associated with serious complications, unrecognized placement of the ET tube tip in the right main stem bronchus may cause hypoxia as well as unilateral pulmonary edema.[57] Obtain a chest radiograph soon after the intubation to confirm tube positioning. Endobronchial intubation was clinically unrecognized without a chest film in 7% of prehospital intubations in one study.[58] Persistent asymmetrical breath sounds after correct tube positioning suggests unilateral pulmonary pathology (e.g., main stem bronchus obstruction, pneumothorax, hemothorax)." (McGill 2009)

Cricoidtryck?
"Sellick's maneuver (application of firm backward-directed pressure over the cricoid cartilage) has long been recommended to minimize the risk of passive regurgitation and, hence, aspiration, but two recent reviews have challenged this premise. In addition, there is evidence that Sellick's maneuver may make laryngoscopy or intubation more difficult in some patients. Accordingly, Sellick's maneuver should be considered optional, applied selectively, and released or modified to improve laryngeal view or tube passage, as indicated." (Walls 2009)
• Cricoid tryck[9]: 1 kg vid induktion, 3 kg vid paralys

Barn: "Cricoid pressure may not be needed, because it has been associated with difficulty with intubation and bag-mask ventilation, and in children cricoid pressure can occlude the pliable trachea. If cricoid pressure is applied, release pressure if laryngoscopy and intubation are difficult." (Tintinalli 2011 Chapter 29)

Vuxna: "The Sellick or cricoid maneuver (application of direct pressure on the cricoid ring in the unconscious or paralyzed patient) generally impairs bag-mask ventilation, worsens the laryngoscopic view, and impairs insertion of the tube over an endotracheal introducer.[2,3] Although evidence does not support its effectiveness in RSI, some practitioners still use it. If the Sellick maneuver is used, release cricoid pressure in the case of difficult ventilation or difficult laryngoscopy." (Tintinalli 2011 Chapter 30)

Referenser

Kabrhel C, Thomsen T, Setnik GS, Walls RM. Orotracheal intubation. N Engl J Med 2007;356;e15

Current Emergency Diagnosis and Treatment

Barker T. Basic airway management in adults. In: UpToDate, Rose BD (Ed), UpToDate, Wellesley (MA), 2012

Holmberg S, Rodling Wahlström M, Winsö O. ABC om Narkos vid ökad aspirationsrisk. Läkartidningen 2006;103:4033-7

"Just a routine operation" (http://www.youtube.com/watch?v=JzlvgtPIof4).

Loftis LL. Emergent evaluation of acute upper airway obstruction in children. In: UpToDate, Rose BD (Ed), UpToDate, Wellesley (MA), 2012

McGill JW, Reardon RF. Chapter 4—Tracheal Intubation. In: Roberts J, Hedges J, editors. Roberts: Clinical Procedures in Emergency Medicine, 5th ed. Philadelphia, WB Saunders, 2009

Nolan JP, Soar J, Zidman DA, Biarent D, Bossaert LL, Deakin C et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 1. Executive summary. Resuscitation 2010;81:1219–76

Reynolds SF, Heffner J. Airway Management of the Critically Ill Patient: Rapid-Sequence Intubation. Chest 2005;127:1397-1412

Bledsoe GH, Schexnayder SM. Pediatric Rapid Sequence Intubation. Pediatric Emerg Care 2004;20:339-44

Reed MJ, Dunn MJ, McKeown DW: Can an airway assessment score predict difficulty at intubation in the emergency department? Emerg Med J 2005;22:99-

Chapter 29— Pediatric Airway Management. I: Tintinalli JE, Stapczynski JS, Ma OJ, Cline DM, Cydulka RK, Meckler BD, redaktörer. Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th edition. McGraw-Hill Companies; 2011

Chapter 30— Tracheal Intubation and Mechanical Ventilation. I: Tintinalli JE, Stapczynski JS, Ma OJ, Cline DM, Cydulka RK, Meckler BD, redaktörer. Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th edition. McGraw-Hill Companies; 2011

Walls RM. Chapter 1: Airway. In: Marx JA, editor. Rosen's Emergency Medicine: Concepts and Clinical Practice, 7th edition. Philadelphia: Elsevier; 2009. pp. 3-22.