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AARC Clinical Practice Guideline

Management of Airway Emergencies

MAE 1.0 PROCEDURE:

Recognition of signs of an impending or actual airway emergency. Initial treatment and continued management of airway emergencies to minimize the likelihood of adverse outcomes, in adults, children, and infants.

MAE 2.0 DESCRIPTION/DEFINITION:

Management of airway emergencies (MAE) for the purpose of this guideline encompasses all care necessary to deal with sudden and often life-threatening events affecting natural and artificial airways and involves the identification, assessment, and treatment of patients in danger of losing or not being able to maintain an adequate airway, including the newborn. This includes (1) identification of the causes of airway emergencies; (2) management of airway emergencies prior to tracheal intubation; (3) use of adjunctive equipment and special techniques for establishing, maintaining, and monitoring effective ventilation; (4) translaryngeal tracheal intubation, including nasal and oral tracheal intubation; (5) transtracheal catheter ventilation, (6) percutaneous dilational cricothyrotomy, and; (7) surgical cricothyrotomy.

MAE 3.0 SETTING:

The guideline applies to a variety of settings including but not limited to hospitals and pre- or interhospital transport.

MAE 4.0 INDICATIONS:

4.1 Conditions requiring management of the airway, in general, are impending or actual (1) airway compromise, (2) respiratory failure, and (3) need to protect the airway. Specific conditions include but are not limited to

4.1.1 Airway emergency prior to endotracheal intubation
4.1.2 Obstruction of the artificial airway
4.1.3 Apnea
4.1.4 Acute traumatic coma(1)
4.1.5 Penetrating neck trauma(2)

4.1.6 Cardiopulmonary arrest and unstable dysrhythmias(3)
4.1.7 Severe bronchospasm(4-8)
4.1.8 Severe allergic reactions with cardiopulmonary compromise(9,10)
4.1.9 Pulmonary edema(11,12)
4.1.10 Sedative or narcotic drug effect(13)
4.1.11 Foreign body airway obstruction(3)
4.1.12 Choanal atresia in neonates(14)
4.1.13 Aspiration
4.1.14 Risk of aspiration
4.1.15 Severe laryngospasm(15)
4.1.16 Self-extubation(16,17)
4.2 Conditions requiring emergency tracheal intubation include, but are not limited to
4.2.1 Persistent apnea
4.2.2 Traumatic upper airway obstruction (partial or complete)(18-20)
4.2.3 Accidental extubation of the patient unable to maintain adequate spontaneous ventilation(16,17)
4.2.4 Obstructive angioedema (edema involving the deeper layers of the skin, subcutaneous tissue, and mucosa)(21-23)
4.2.5 Massive uncontrolled upper airway bleeding(2,24)
4.2.6 Coma with potential for increased intracranial pressure(25)
4.2.7 Infection-related upper airway obstruction (partial or complete)
4.2.7.1 Epiglottitis in children or adults(26,27)
4.2.7.2 Acute uvular edema(28)
4.2.7.3 Tonsillopharyngitis or retropharyngeal abscess(29)
4.2.7.4 Suppurative parotitis(30)
4.2.8 Laryngeal and upper airway edema(31)
4.2.9 Neonatal- or pediatric-specific
4.2.9.1 Perinatal asphyxia(32,33)
4.2.9.2 Severe adenotonsillar hypertrophy(34,35)
4.2.9.3 Severe laryngomalacia(36,37)
4.2.9.4 Bacterial tracheitis(38-40)
4.2.9.5 Neonatal epignathus(41,42)
4.2.9.6 Obstruction from abnormal laryngeal closure due to arytenoid masses(43)
4.2.9.7 Mediastinal tumors(44)
4.2.9.8 Congenital diaphragmatic hernia(45)
4.2.9.9 Presence of thick and/or particulate meconium in amniotic fluid(46-48)
4.2.10 Absence of airway protective reflexes
4.2.11 Cardiopulmonary arrest
4.2.12 Massive hemoptysis(49)
4.3 The patient in whom airway control is not possible by other

methods may require surgical placement of an airway (needle or surgical cricothyrotomy).(20,50,51)
4.4 Conditions in which endotracheal intubation may not be possible and in which alternative techniques may be used include but are not limited to
4.4.1 restriction of endotracheal intubation by policy or statute;
4.4.2 difficult or failed intubation in the presence of risk factors associated with difficult tracheal intubations(52) such as
4.4.2.1 Short neck,(53) or bull neck(54)
4.4.2.2 Protruding maxillary incisors(53)
4.4.2.3 Receding mandible(53)
4.4.2.4 Reduced mobility of the atlanto-occipital joint(55)
4.4.2.5 Temporomandibular ankylosis(55)
4.4.2.6 Congenital oropharyngeal wall stenosis(56)
4.4.2.7 Anterior osteophytes of the cervical vertebrae, associated with diffuse idiopathic skeletal hyperostosis(57)
4.4.2.8 Large substernal and/or cancerous goiters(58)
4.4.2.9 Treacher-Collins syndrome(59)
4.4.2.10 Morquio-Brailsford syndrome(60)
4.4.2.11 Endolaryngeal tumors(61)
4.4.3 when endotracheal intubation is not immediately possible

MAE 5.0 CONTRAINDICATIONS:

Aggressive airway management (intubation or establishment of a surgical airway) may be contraindicated when the patient's desire not to be resuscitated has been clearly expressed and documented in the patient's medical record or other valid legal document.(62-64)

MAE 6.0 PRECAUTIONS/HAZARDS AND/OR COMPLICATIONS:

The following represent possible hazards or complications related to the major facets of management of airway emergencies:
6.1 Translaryngeal intubation or cricothyrotomy is usually the route of choice. It may be necessary occasionally to use a surgical airway. Controversy exists as to whether intubation is hazardous in the presence of an unstable injury to the cervical spine. In one series the incidence of serious cervical spine injury in a severely injured population of blunt trauma patients was relatively low, and commonly used methods of precautionary airway management rarely led to neurologic deterioration.(65-67)
6.1.1 Failure to establish a patent airway(68-70)
6.1.2 Failure to intubate the trachea(68,69)
6.1.3 Failure to recognize intubation of esophagus(25,68,71-81)
6.1.4 Upper airway trauma, laryngeal, and esophageal damage(82)
6.1.5 Aspiration(70,74,82,83)

6.1.6 Cervical spine trauma(67,84,85)
6.1.7 Unrecognized bronchial intubation(25,68,72,82,86,87)
6.1.8 Eye injury(70)
6.1.9 Vocal cord paralysis(88)
6.1.10 Problems with ETT tubes
6.1.10.1 Cuff perforation(89)
6.1.10.2 Cuff herniation(89)
6.1.10.3 Pilot-tube-valve incompetence(90)
6.1.10.4 Tube kinking during biting(70,89)
6.1.10.5 Inadvertent extubation(17,25,68,72,86,91-93)
6.1.10.6 Tube occlusion(17,72,82,89,93,94)
6.1.11 Bronchospasm(68,70,74)
6.1.12 Laryngospasm(72)
6.1.13 Dental accidents(70)
6.1.14 Dysrhythmias(94)
6.1.15 Hypotension and bradycardia due to vagal stimulation(94)
6.1.16 Hypertension and tachycardia(94,95)
6.1.17 Inappropriate tube size(89,96-99)
6.1.18 Bleeding
6.1.19 Mouth ulceration(82)
6.1.20 Nasal-intubation specific
6.1.20.1 Nasal damage including epistaxis
6.1.20.2 Tube kinking in pharynx
6.1.20.3 Sinusitis(100-102) and otitis media
6.1.21 Tongue ulceration
6.1.22 Tracheal damage including tracheoesophageal fistula, tracheal innominate fistula, tracheal stenosis, and tracheomalacia(103-107)
6.1.23 Pneumonia(108)
6.1.24 Laryngeal damage with consequent laryngeal stenosis,(82,101,107,109,110) laryngeal ulcer, granuloma, polyps, synechia
6.1.25 Surgical cricothyrotomy or tracheostomy specific(111,112)
6.1.25.1 Stomal stenosis(82,113)
6.1.25.2 Innominate erosion(113)
6.1.26 Needle cricothyrotomy specific(114-118)
6.1.26.1 Bleeding at insertion site with hematoma formation
6.1.26.2 Subcutaneous and mediastinal emphysema(117)
6.1.26.3 Esophageal perforation
6.2 Emergency ventilation
6.2.1 Inadequate oxygen delivery(119-121)
6.2.2 Hypo- or hyperventilation(122-124)
6.2.3 Gastric insufflation and/or rupture(125,126)
6.2.4 Barotrauma(127-129)
6.2.5 Hypotension due to reduced venous return secondary to high

mean intrathoracic pressure(130-132)
6.2.6 Vomiting and aspiration(125)
6.2.7 Prolonged interruption of ventilation for intubation(3,126)
6.2.8 Failure to establish adequate functional residual capacity in the newborn(133-135)
6.2.9 Movement of unstable cervical spine (more than by any commonly used method of endotracheal intubation).(136)
6.2.10 Failure to exhale due to upper airway obstruction during percutaneous transtracheal ventilation.(118,136)

MAE 7.0 LIMITATIONS OF PROCEDURE:

Despite adequate management of airway emergencies, desired outcome may not be achieved because of the patient's underlying condition and progression of the process leading to the need for emergency airway management.

MAE 8.0 ASSESSMENT OF NEED:

The need for management of airway emergencies is dictated by the patient's clinical condition. Careful observation, the implementation of basic airway management techniques, and laboratory and clinical data should help determine the need for more aggressive measures. Specific conditions requiring intervention include
8.1 Inability to adequately protect airway (eg, coma, lack of gag reflex, inability to cough) with or without other signs of respiratory distress.
8.2 Partially obstructed airway. Signs of a partially obstructed upper airway include ineffective patient efforts to ventilate, paradoxical respiration, stridor, use of accessory muscles, patient's pointing to neck, choking motions, cyanosis, and distress. Signs of lower airway obstruction may include the above and wheezing.
8.3 Complete airway obstruction. Respiratory efforts with no breath sounds or suggestion of air movement are indicative of complete obstruction.
8.4 Apnea. No respiratory efforts are seen. May be associated with cardiac arrest.
8.5 Hypoxemia, hypercarbia, and/or acidemia seen on arterial blood gas analysis, oximetry or exhaled gas analysis.
8.6 Respiratory distress. Elevated respiratory rate, high or low ventilatory volumes, and signs of sympathetic nervous system hyperactivity may be associated with respiratory distress.

MAE 9.0 ASSESSMENT OF PROCESS AND OUTCOME:

Timely intervention to maintain the patient's airway can improve outcome in terms of survival and level of function. Under rare circumstances, maintenance of an airway by nonsurgical means may

not be possible. Despite optimal maintenance of the airway, patient outcomes are affected by patient-specific factors. Lack of availability of appropriate equipment and personnel may adversely affect patient outcome. Monitoring and recording are important to the improvement of the process of emergency airway management. Some aspects (eg, frequency of complications of tracheal intubation or time to establishment of a definitive airway) are easy to quantitate and can lead to improvement in hospitalwide systems. Patient condition following the emergency should be evaluated from this perspective.

MAE 10.0 RESOURCES:

10.1 Personnel: All health professionals should be trained, evaluated at frequent intervals, and retrained as necessary in the skills of emergency clearance of foreign body airway obstruction and airway secretions. Health professionals who are primary members of resuscitation teams in acute care hospitals should be skilled in advanced management of airway emergencies, emergency cardiac care (ECC), and advanced cardiac life support (ACLS).(137)

Emergency response system-a designated resuscitation team should be continuously available (24 hours/day, 7 days/week) to assist with the management of airway emergencies. Team members should be notified simultaneously. All hospital workers must know how to activate the hospital's emergency response system.(137)

10.1.1 Level I

10.1.1.1 Training-all Level I personnel should be trained, evaluated by performance, and retrained as necessary in clearance of foreign-body airway obstruction, emergency airway-secretion evacuation techniques, and basic life support (BLS) at frequent intervals that do not exceed one year. Retraining should focus on identified deficiencies.

10.1.1.2 Responsibilities-Level I personnel are health professionals who assist the primary (Level II) members of the health-care team. They should be capable of assisting Level II personnel by (1) assessing patients for airway emergencies, respiratory, and/or cardiac arrest, (2) activating the resuscitation team, (3) administering BLS, (4) clearing the airway of foreign-body obstruction or material with the potential for obstruction, (5) providing mouth-to-mask ventilation, (6) assisting with tracheal intubation, (7) attaching pulse oximeter and capnograph, (8) moving adjunct airway equipment to the scene, (9) collecting arterial blood for analysis, (10) making a written record of resuscitation efforts.

10.1.1.3 Credentials-Level I health professionals should hold one or

more of the following or equivalent credentials: RRT, CRTT, RN, MD, or DO; and have current BLS health-care provider-course completion card from the American Heart Association or a similar equivalent organization. Health professionals and hospital personnel not holding one of these Level I credentials should at a minimum be capable of assessing the patient for foreign-body airway obstruction, activating the resuscitation team, and administering BLS until the team arrives.

10.1.2 Level II

10.1.2.1 Training-Level II personnel should be trained, evaluated by performance, and retrained as necessary in advanced management of airway emergencies-ACLS and/or pediatric advanced life support (PALS) and/or neonatal resuscitation program (NRP)-as appropriate at intervals that should not exceed 1 year. To maintain operator competence, certain procedures (eg, endotracheal intubation) need to be reinforced as often as every 3 months. Retraining should focus on identified deficiencies.

10.1.2.2 Responsibilities-Level II health professionals should be capable of serving as primary members of the resuscitation team. They may respond not only to airway emergency calls in their work areas but also to other areas of the hospital. They are skilled in the use of all adjunctive equipment and special techniques for ECC/ACLS, eg, establishing, maintaining, and monitoring effective ventilation and circulation as described in more detail in the AARC Clinical Practice Guideline: Resuscitation in the Acute Care Hospital.137 They have the skills of Level I personnel and also the following capabilities: (1) advanced ECG monitoring and dysrhythmia recognition, (2) tracheal intubation and airway stabilization; (3) establishing ventilation via transtracheal catheter and cricothyrotomy; (4) emergency treatment of tension pneumothorax or hemothorax with large bore needle; (5) preparing patients for emergency transport; (6) use of continuous and transport mechanical ventilators, (7) evaluating oxygenation, ventilation and acid-base balance from blood gas reports.(138-141)

10.1.2.3 Credentials-Level II health professionals should hold one or more of the following credentials: RRT, RN, MD, or DO; and current ACLS, PALS, and/or NRP course-completion card from the American Heart Association or a similar equivalent association.

10.2 Equipment should be rapidly available and functional. Durability, portability, reliability, and cost should be considered

10.2.1 Ventilation devices should comply with the recommendations made in the AARC Guideline: Resuscitation in the Acute Care Hospital.(137)

10.2.2 Airway management devices should comply with the recommendations made in the AARC Guideline: Resuscitation in the Acute Care Hospital.137 Some other airway devices are available (eg,

laryngeal mask airway, esophageal obturator airway, combination esophageal-tracheal tubes) and may be acceptable and useful although they do not provide the airway control and protection afforded by an endotracheal tube.(142)

10.2.2.1 The laryngeal mask airway (LMA) provides a low-pressure seal around the glottis. Although its size effectively prohibits its being inserted into either the trachea or the esophagus, it does not reliably protect the airway from aspirated gastric contents. It may cause less airway trauma than the endotracheal tube and less cardiovascular instability. Available in sizes 1-4, it works in children as well as adults. It may be easier to insert in patients with higher Mallampati classifications.(69,143-151)

10.2.2.2 The esophageal obturator airway/esophageal gastric tube airway (EOA/EGTA) are considered together. Although researchers originally claimed it required less time for training than the endotracheal tube, this may not be the case. It is still widely used, primarily in prehospital care of adults. There have been several reports of the effectiveness of the EOA, but comparison is difficult due to variability in patients and in the medical supervision of the systems. Complications have been reported in many studies. While some believe it to be a useful second-line airway adjunct (for keeping gas out of the stomach and stomach contents out of the pharynx), others feel that the time used for training in EOA insertion would be better spent in training for endotracheal intubation or, failing that, placing more emphasis on basic airway maintenance and ventilation.(152-163)

10.2.2.3 The pharyngeotracheal lumen airway (PTL) is a double-lumen tube that is inserted blindly into the pharynx. After the position of the tube has been assessed, the patient is ventilated through the appropriate lumen. A large pharyngeal balloon seals the airway and a smaller secondary balloon is then inflated. The published complication rate is low, but there has been relatively little evaluation of this device.(164,165)

10.2.2.4 The esophageal tracheal Combitube (ETC) is the newest airway device to be developed. It is similar to the PTL in that it is a double-lumen tube that is inserted blindly into the oropharynx; the position of the tube is assessed; and the patient is ventilated through the appropriate lumen. It has both a low reported rate of complications and few published evaluations.(24,166-172)

10.2.2.5 A 12-16 gauge intravenous catheter-over-the-needle device is used to initiate transtracheal catheter ventilation with the breathing mixture supplied at high pressure (30-50 psi). Because exhalation with this device must occur passively through the upper airway, CO_2 excretion is usually inadequate. This technique has potential for providing oxygen to the patient with a partially obstructed airway.

10.2.2.6 Percutaneous dilational cricothyrotomy is performed by making a small vertical incision and advancing a cricothyrotomy tube over a guidewire and dilator.(173) If the catheter is improperly placed or becomes dislodged, ventilation and oxygenation will fail and barotrauma will occur (eg, massive subcutaneous emphysema, pneumomediastinum, pneumothorax, bleeding).
10.2.2.7 Surgical cricothyrotomy requires experience, skill, and specialized equipment and may be facilitated by a tracheal dilator or tracheal hook and a standard tracheostomy or endotracheal tube.
MAE 11.0 MONITORING:

11.1 Patient
11.1.1 Clinical signs-continuous observation of the patient and repeated clinical assessment by a trained observer provide optimal monitoring of the airway. Special consideration should be given to the following:(174)
11.1.1.1 Level of consciousness
11.1.1.2 Presence and character of breath sounds
11.1.1.3 Ease of ventilation
11.1.1.4 Symmetry and amount of chest movement
11.1.1.5 Skin color and character (temperature and presence or absence of diaphoresis)
11.1.1.6 Presence of upper airway sounds (crowing, snoring, stridor)
11.1.1.7 Presence of excessive secretions, blood, vomitus, or foreign objects in the airway
11.1.1.8 Presence of epigastric sounds
11.1.1.9 Presence of retractions
11.1.1.10 Presence of nasal flaring
11.1.2 Physiologic variables-Repeated assessment of physiologic data by trained professionals supplements clinical assessment in managing patients with airway difficulties. Monitoring devices should be available, accessible, functional, and periodically evaluated for function. These data include but are not limited to:(142,175)
11.1.2.1 Ventilatory frequency, tidal volume, and airway pressure
11.1.2.2 Presence of CO2 in exhaled gas
11.1.2.3 Heart rate and rhythm
11.1.2.4 Pulse oximetry
11.1.2.5 Arterial blood gas values
11.1.2.6 Chest radiograph
11.2 Endotracheal tube position-Regardless of the method of ventilation used, the most important consideration is detection of esophageal intubation.
11.2.1 Tracheal intubation is suggested but may not be confirmed bY
11.2.1.1 bilateral breath sounds over the chest, symmetrical chest

movement, and absence of ventilation sounds over the epigastrium;(174,175,177)
11.2.1.2 presence of condensate inside the tube, corresponding with exhalation;(174,176,177)
11.2.1.3 visualization of the tip of the tube passing through the vocal cords;
11.2.1.4 Esophageal detector devices may be useful in differentiating esopha-geal from tracheal intubation.(178,179)
11.2.2 Tracheal intubation is confirmed by detection of CO2 in the exhaled gas,(180-182) although cases of transient CO2 excretion from the stomach have been reported.(183)
11.2.3 Tracheal intubation is confirmed by endoscopic visualization of the carina or tracheal rings through the tube.
11.2.4 The position of the endotracheal tube (ie, depth of insertion) should be appropriate on chest radiograph.
11.3 Airway Management Process-a properly managed airway may improve patient outcome. Continuous evaluation of the process will identify components needing improvement. These include response time, equipment function, equipment availability, practitioner performance, complication rate, and patient survival and functional status.

MAE 12.0 FREQUENCY/AVAILABILITY/ DURATION:

Because the need for management of airway emergencies occurs unpredictably, personnel need to be able to respond with the appropriate equipment within 3 minutes, 24 hours/day, 7 days/week.(184) Additionally, a person capable of airway management in the infant should be present at every delivery. A Level-II practitioner should be present at every high-risk delivery.

MAE 13.0 INFECTION CONTROL:

13.1 Implement Universal Precautions including mouth-to-barrier devices and recommendations related to avoidance of the transmission of tuberculosis and other airborne diseases.(185,186)
13.2 Observe all infection control guidelines posted for the patient.
13.3 Disinfect all equipment to be reused on other patients.

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