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Airway Management in Everyday Practice

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Abstract

The term airway in everyday use refers to the upper part of the respiratory system that is used for conduction of air into the lungs, there is no gas exchange and it consists of the mouth and nasal cavity, pharynx, larynx, trachea and large bronchi. Loss of consciousness, trauma, allergic reactions, presence of foreign body in the upper respiratory tract, anesthesia due to diagnostic or therapeutic procedures are conditions that require airway control. Airway control and ventilation play a key role in preventing damage of the brain and other vital organs.

Keywords: Airway Management, Anaesthesia, Complications, Patient

Introduction

Anaesthesia dates from prehistoric times in the form of opium, and the first documented recipes are recorded by the ancient Egyptians [1]. The birth of modern anaesthesia is considered to have occurred in 1846 when William Morton publicly administered ether in Massachusetts General Hospital. His first public demonstration of the use of ether was complicated by a failure to induce anaesthesia.

We perceive anaesthesia and surgery as a safe process. Indeed, mortality related directly to anaesthesia is now estimated to be less than 1 in 250,000. However, despite the improved safety record, complications will inevitably occur in relation to anaesthesia. Some are related to the anaesthesia alone, some related to surgery, but the majority of complications relate to the complex interaction between anaesthesia, surgery, the patient's condition and human factors.

Complications occurring during anaesthesia are often minor but they can lead to serious health problems, disability and death. The ability to competently manage a complication, however minor, can significantly reduce the risk of harm to the patient. The successful management of a complication relies upon the recognition that a complication has occurred, or is occurring, followed by a series of actions requiring knowledge, technical skills and behaviours that mitigate the consequences of the complication.

One of this complications is connnected with airway. Clinical factors such as the patient's current mental status and level of consciousness, the degree of respiratory distress based on respiratory rate, audible wheezing or stridor, and O_2 saturation on pulse oximetry will influence with choice intubate or not at the scene. The specialty training of the first responders will have a major effect on this decision because of their ability to provide O_2 supplementation, skilled bag-mask support, available induction medications, the skill and judgment of using such medications, and finally the skill and jurisdiction to perform tracheal intubation. The distance from the scene of the accident to the medical facilities and any perceived or predicted rapid airway deterioration may alter airway management decisions [2].

The "scoop and run" approach that is only 10 minutes away will vary widely from the physician–nurse-based treatment rendered at the scene by many emergency care provider teams based in Europe.

Goal

The goal of airway management is to safely maintain ventilation and prevent contamination of the patient's lungs [3]. Following induction of general anaesthesia control of the airway moves from patient to anaesthetist. Airway interventions by the

anaesthetist may be responsible for adverse events. Most airway complications are minor and require no treatment but add to the morbidity and discomfort attributed to anaesthesia. Dental damage is the most common cause of anaesthesia-related litigation. Airway trauma, aspiration and prolonged hypoxia can result in severe harm or death. Recent UK figures show complications resulting from airway events account for 20% of the most expensive anaesthesiarelated claims settled by the National Health Service Litigation Authority (NHSLA). Aside from the time and expense involved in processing these cases, many of these unfortunate patients, their relatives and anaesthesia providers suffer long-term consequences following serious adverse events.

Examination

After an appropriate physical examination, the area can be anesthetized (neurologic exam should always be performed before anesthesia) [4]. This can be accomplished by systemic, regional, or local anesthesia. Systemicanalgesiamaybenecessary for some large wound sorin some children. It can be accomplished with a number of different agents, including ketamine, benzodiazepines, narcotics, oretomidate. Regional anesthesia is preferred when applicable because it usually requires less anesthetic, can cover multiple wounds in the same area, and does not distort the wound. However, local anesthesia is simple to perform and appropriate for many wounds.

Anesthetic agents can be divided into two classes the amides and the esters. There is no cross-reactivity between the groups, so an allergy toan amide does not mean an allergy to an ester. Examples of the amides are lidocaine, mepivacaine, andbupivacaine. The esters include procaine, tetracaine, and benzocaine. The two most commonly available local anesthetics in the United States are lidocaine and bupivacaine. Both come with and without epinephrine. Epinephrine causes vasoconstriction, which helps control bleeding and decreases the speed of systemic absorption (thereby allowing for higher doses to be administered). Epinephrine has also been shown to delay healing and increase the risk of infection and, because of the small risk of necrosis, it should not be used where there are distal-end arteries such as in the fingers, nose, penis, and toes.

Complications

Airway obstruction in the spontaneously breathing patient has many causes, including aspirated foreign bodies, infections (e.g., epiglottitis, diphtheria, Ludwig's angina), laryngospasm, bronchospasm, tumor or a hematoma impinging on the airway, airway trauma, tonsillar hypertrophy, obstructive sleep apnea, nasopharyngeal and oral packing, and airway edema (e.g., anaphylaxis, smoke inhalation, burn injury) [5].

Complications occurring during anaesthesia can be due to the deterioration of a patient's condition or errors [1]. Errors can involve human factors, equipment problems, medication errors, technical problems or misjudged severity of the patient's condition. The majority of errors in medical practice are due to human factors. They may result from inadequate training and experience, a challenging working environment, poor team-working, stress and fatigue. However, most complications are multifactorial and it is seldom that a complication occurs due to a single factor. In the UK, healthcare organizations are required by law to have implemented processes to reduce the risks to which patients are exposed. The knowledgeof how and why complications occur and methods to avoid and manage complications is a powerful tool in the armoury of all healthcare providers.

The signs of an obstructed airway are cyanosis (blue), apnoea (not breathing) and stridor (a rasping noise on respiration) [6]. It is essential to protect and secure an adequate airway.The lungs cannot oxygenate the blood if the airway is obstructed by the jaw and tongue falling back,swollen soft tissues,direct damage to the upper airway,false teeth,vomitus or blood.

The airway of unconscious patients lying on their back often becomes obstructed by their own intraoral soft tissues, but before they are rolled into the supine or semi-prone position,or the neck extended, always consider, and if possible exclude, an associated cervical spinal injury

All patients found to be unconscious after an injury must be assumed to have an associated injury oftheir cervical spine because abrupt or careless turning may further dislocate or sublux a cervical vertebra and injure the spinal cord when no injury existed, or turn partial cord damage into a complete transection.The neck should therefore be immobilized in all unconscious injured patients by longitudinal, manual support,the application of a hard collar and the use of stabilizing sand bags and tape before turning the patient onto their side, until clinical examination and radiographs have excluded unstable fractures of the cervical spine.

Compromises are inevitable if an immobilizing collar is not available at the site ofinjury.The presence oftwo first-aiders may allow one to support the neck while the other assesses and manually clears the airway,feels the neck and jaws,and assesses the respiratoryeffort by palpating the chest during respiration.

Airway obstruction is often relieved by lifting the jaw upwards,but may only be relieved by inserting a finger in the mouth and pulling the jaw or palate forward, especially when the obstruction is associated with a fractured maxilla or mandible.

An oropharyngeal or nasopharyngeal airway should be inserted as soon as possible, and then, in an unconscious patient, replaced by an endotracheal tube, inserted by an experience anaesthetist, because the absence of a gag reflex in an unconscious patient makes aspiration of saliva,vomitus or blood into the lungs a major hazard.

The upper airway consists of the pharynx, nose, mouth, larynx, trachea, and main-stem bronchi [7]. Th e mouth and pharynx are also a part of the upper gastrointestinal tract. The laryngeal structures in part serve to prevent aspiration into the trachea.

There are two openings to the human airway: the nose, which leads to the nasopharynx, and the mouth, which leads to the oropharynx. Th ese passages are separated anteriorly by the palate, but they join posteriorly in the pharynx. The pharynx is a U-shaped fibromuscular structure that extends from the base of the skull to the cricoid cartilage at the entrance to the esophagus. It opens anteriorly into the nasal cavity, the mouth, the larynx, and the nasopharynx, oropharynx, and laryngopharynx, respectively. The nasopharynx is separated from the oropharynx by an imaginary plane that extends posteriorly. At the base of the tongue, the epiglottis functionally separates the oropharynx from

the laryngopharynx (or hypopharynx). The epiglottis prevents aspiration by covering the glottis-the opening of the larynx-during swallowing. The larynx is a cartilaginous skeleton held together by ligaments and muscle. The larynx is composed of nine cartilages: thyroid, cricoid, epiglottic, and (in pairs) arytenoid, corniculate, and cuneiform. The thyroid cartilage shields the conus elasticus, which forms the vocal cords.

Problem: An anaesthetic complication is an unfavourable outcome that arises following the provision of anaesthesia, or following a procedure or treatment undertaken by an anaesthetist [3]. Anaesthetists are trained with the intention of providing them with the skills required to assess and balance risk for those in their care and to respond to unanticipated hazards to reduce harm to their patients. Dealing with the aftermath of an unforeseen complication is also a necessary skill.

Safety is at the core of anaesthetic practice. An anaesthetic complication has implications primarily for the patient but also for the anaesthetist. Complications are a source of stress to both patients and healthcare staff and can lead to complaints and litigation. The subsequent management of complications can greatly influence the outcome for patients, in terms of satisfaction or dissatisfaction, and the likelihood of legal action.

Airway problems may occur at any stage of an anaesthetic [8]. Most (70%) events occur at induction of anaesthesia or during emergence or recovery (15%). These are high-stress periods for anaesthetists as complex pharmacological, physiological and pathological interactions take place. Airway problems often present at a time when the anaesthetist may be distracted by other considerations. When oxygenation is compromised time is limited and prompt action is needed if severe hypoxia and brain injury or death is to be avoided. All anaesthetists should have an airway strategy for managing unexpected problems with mask ventilation and tracheal intubation, including the 'can't ventilate, can't intubate' (CVCI) scenario.

The Difficult Airway Society (DAS) have produced guidelines for management of the unanticipated difficult intubation. These guidelines outline the options for maintaining oxygenation and have been widely adopted. An airway strategy should incorporate alternative methods of ventilation, including surgical airway. For the plan to be effective it must be compatible with the skills of the anaesthetist and the equipment available. Airway management plans should emphasize the need to get help, to limit airway trauma by making best use of each intervention, to re-appraise the situation regularly and if feasible to abandon attempts before serious harm results.

A difficult airway exists in a patient when conventional face mask ventilation is problematic or tracheal intubation is difficult, requiring advanced airway skills for success [9]. Patient factors such as micrognathia, a short neck, a large tongue, craniofacial abnormalities, pregnancy, and obesity are chronic conditions associated with a difficult airway but do not inherently define a difficult airway. Other conditions such as angioedema, epiglottitis, Ludwig's angina, retropharyngeal abscess, tracheal trauma, traumatic/expanding neck hematoma, and cervical trauma are examples of acute factors that similarly may cause a difficult airway condition to exist. When patients with any of these conditions develop dyspnea or respiratory distress, immediate action is required to avert life-threatening decompensation or permanent debility. Furthermore, these patients can present at any time: a patient with a penetrating neck injury may present to an ED without warning, or a long-term ICU (Intensive care unit) patient with diffuse soft tissue edema and a beard may unexpectedly decompensate and require intubation. Therefore, in a variety of settings, clinicians must be prepared for rapid escalation of care and difficult airway management.

In the ICU, airway management is a common challenge in daily practice. For critical care physicians, its importance cannot be overemphasized [10]. A number of techniques must be mastered, ranging from merely lifting the chin to emergency tracheostomy. Physicians confronted with airway problems must decide whether to intervene.This requires rapid assessment of several factors such as the duration of hypoxia, the current status of the airway and ventilation, the presence of jaw clenching, cervical spine stability, prior difficulties with intubation, and available equipment and skills. Contingency plans for various potential airway emergencies must be in place and familiar to all ICU personnel. The risk of irreversible hypoxic damage always should dictate priorities in the decision algorithm. Gloves and goggles are indicated for personal protection during manipulations of the airway.

Obstetrics: Airway difficulties associated with failed intubation are very common in obstetric patients (approximately 1:238 compared with 1:2220 in non-pregnant population) [11]. Failed intubation reflects the relatively high incidence in the pregnant population. This high incidence among parturients could be due to changes in soft tissues of the airway mucosa, swollen and engorged breasts along with full dentition.

Therefore it is imperative to try and identify beforehand airway that is likely to prove difficult. Some bedside assessments are carried out to identify potential airway problems but unfortunately these tests have very low predictive values amongst obstetric patients. Generally, difficult intubation is frequently common in parturients with the following physical characteristics:

- Inability to see the uvula or soft palate when the patient is asked to open her mouth and protrude her tongue in a sitting position
- Receding mandible
- Protruding maxillary incisors
- A short neck
- keeping a packed African hair style

Nevertheless, the management of the airway is the responsibility of the attending Anesthetist. It is important to note that a difficult airway exists when the attending Anesthetist has difficulties with mask ventilation, tracheal intubation or both. The incidence of mask ventilation is 5%. However, a poorly managed airway may be associated with airway trauma or cardiac or neurological hypoxic injury.

Management: Airway obstruction can occur from functional, pathologic, or mechanical causes [12]. Functional obstruction can occur in the patient with adepressed level of consciousness, as loss of muscular tone results in posterior relaxation of the soft

palate, tongue, and epiglottis toward the posterior pharyngeal wall. Functional obstruction will most often be alleviated by BLS (basic life support) maneuvers such as head tilt or chin lift (unless contraindicated by C-spine precautions in the trauma patient), or, more effectively, a jaw thrust. If respiratory effort is still present, adequate gas exchange can then resume, although intubation may still be indicated to maintain ongoing airway patency.

In the apneic patient, initial BLS maneuvers are still indicated to assess and establish airway patency, but positive pressure ventilation with BMV (bag-mask ventilation) will be the next step to reoxygenate the patient. Here again, unless the cause of the apnea can be rapidly corrected, intubation will be indicated to maintain a patent airway.

Pathologic airway obstruction may result from an intrinsic process such as edema, hematoma, infection, or tumor, while mechanical obstruction can occur from extrinsic processes such as excessive application of cricoid pressure or foreign body. Pathologic airway obstruction is rarely quickly corrected and often requires intubation to obtain and maintain a patent airway while the underlying cause of obstruction is addressed.

Obstructive lesions within the airway are not uncommon and may present with severe respiratory distress and stridor [8]. They may require urgent tracheal intubation or anemergency surgical airway. This group represents the most common reason for CVCI during anaesthesia. Causes include laryngeal tumours, epiglottitis, laryngeal oedema, or foreign body within the airway. If direct laryngoscopy is attempted the anatomy may be unrecognizable and tracheal intubation difficult or impossible.

Difficult airway management should be expected in patients with advanced airway obstruction. Airway imaging and nasendoscopy findings should be reviewed if available. Total airway obstruction may occur at any time and the need for a surgical airway must be anticipated. Good communication is required between all theatre staff. The anticipated problems and the planned solutions should be made clear to all. A tracheostomy performed under local anaesthesia may be the primary plan. Where tracheal intubation is the preferred airway management option this should still take place in an operating theatre. An experienced surgeon should be scrubbed and ready to proceed to a surgical airway if either mask ventilation or tracheal intubation is impossible.

The aim is to achieve maximal oxygenation, therefore 100% oxygen should be used. Inhalational general anaesthesia is slow and difficult in these patients. Spontaneous ventilation may improve during induction with application of CPAP but coughing or premature instrumentation of the airway may precipitate total airway obstruction. Preoxygenation, IV induction and muscle relaxant provides optimal conditions for laryngoscopy, tracheal intubation or an emergency surgical airway if required. This imposes a strict time limit. If mask ventilation is found to be impossible an early surgical airway is needed. Where mask ventilation is possible and laryngoscopy suggests tracheal intubation may be difficult or traumatic it may be safer to avoid tracheal intubation altogether and proceed directly to tracheostomy.

Recognising that preparation for an operative procedure commences long before attendance of the surgical staff, then there are clearly leadership responsibilities entailed in procedural preparation and planning for which reside with the nursing staff [13]. By the same token, the task load of the nursing staff begins to escalate at the time when the surgical operation is coming to an end.

As the surgeons task load diminishes and closure begins, then the scrub nurses' work increases with equipment checks, swap counts, appropriate labelling and disposal of surgical specimens and even planning forward into the next case on the operating list. Similarly induction of anaesthesia and wakening the patient are "task- heavy" phases of the anaesthetists' schedule. At those points in the operating list, leadership is dispersed if not devolved across those subteams. With leadership, so goes responsibility and whilst there is recognition that the surgeon has overall responsibility in both clinical and a medico-legal sense, there are specific elements to an operative procedure where the responsibility is uniquely allocated to an individual (as in the case of airway management during anesthesia), and in those procedure specific phases, the leadership belongs to those with responsibility.

Emergency: What happens if the sedation is too deep for the stimulation level of the procedure, or if the patient progresses to a deeper plane of sedation than initially intended [14]? Obviously the above manipulations are first attempted, including voice, jaw thrust, and/or sternal rub. If this does not suffice, a nasal trumpet may be placed assuming there are no contraindications such as facial fractures, coagulopathy, etc. If the patient's breathing continues to decline, manual assisted ventilation must begin, often with a bag-valve-mask device or other circuit capable of delivering high flow oxygen. If the airway status continues to decline, on rare occasion, the patient may need to be intubated.

The emergency medicine physician is skilled at emergency airway management and can quickly proceed with rapid sequence intubation. Pre- oxygenation is begun and suction is moved to the head of the bed. The most common drugs used for rapid sequence intubation in the ED are etomidate and succinylcholine. At times, rocuronium is also used. All ED patients are considered to have a full stomach and rapid sequence intubation is the safest method to secure the airway in the ED and prevent aspiration. Although it is rare to proceed with intubation during procedural sedation in the emergency department, it is essential to review the best means to perform it for the sake of completeness of the procedure and to fully review all aspects of procedural sedation in the ED.

There are many details essential to the performance of rapid sequence intubation in the emergency department. First of all, cricoid pressure was considered to be an essential part of the process for many years. An assistant places pressure over the mid trachea with two fingers in the hopes of closing the esophagus and preventing aspiration of stomach contents during the intubation process. Of late, there has been much discussion and debate as to the utility of this part of the procedure.

Does cricoid pressure help? Does it prevent aspiration?. The application of cricoid pressure developed in response to expert opinion. There was never a large body of evidence that prompted its use. It has recently been noted that indeed it may not prevent aspiration during rapid sequence intubation, but rather may worsen aspiration risk and cause harm. Cricoid pressure may increase peak inspiratory pressuresduring hand assisted ventilation, which

may be necessary as a response to hypoxia. In turn, this may cause further gastric insufflation. Also, it may decrease lower esophageal pressure, thereby worsening aspiration risk. Often, it will worsen the view of the laryngoscopist during the intubation process. This can be extremely detrimental by delaying intubation. The best means to prevent aspiration during emergent intubation is to use rapidly acting induction anesthetics coupled with a rapidly acting neuromuscular blocking agent. With adequate pre-oxygenation, the goal is to avoid hand assisted ventilation whenever possible. This is the best way to prevent aspiration.

Patient: Patients who are conscious and have a normal voice do not require further evaluation or early attention to their airway [15]. Exceptions to this principle include patients with penetrating injuries to the neck and an expanding hematoma; patients with evidence of chemical or thermal injury to the mouth, nares, or hypopharynx; and patients with extensive subcutaneous air in the neck, complex maxillofacial trauma, or airway bleeding. These patients initially may have a satisfactory airway, but it may become obstructed if soft tissue swelling or edema progresses.

Patients who have an abnormal voice or altered mental status require further airway evaluation. Direct laryngoscopic inspection often reveals blood, vomit, the tongue, foreign objects, or soft tissue swelling as sources of airway obstruction. Suctioning can offer immediate relief in many patients. Altered mental status is the most common indication for intubation because of the patient's inability to protect the airway. Options for airway access include nasotracheal intubation, orotracheal intubation, or operative intervention.

Before agreeing to any medical intervention, a patient must be in possession of all of the relevant information to allow a reasoned appraisal prior to deciding what to do [16]. The information that is given must include an assessment of the risks that a particular procedure may present. By explaining to the patient the nature and extent of the possible complications, the doctor fulfils a moral and legal duty that enables the process of consent. In general, to limit the harm to a patient as a result of a medical procedure, the starting point must be a well informed participant who has made an autonomous decision free from undue influence and accepts the risks involved.

The foundation of the doctor–patient relationship is trust. This is necessary to permit actions related to diagnosis and treatment to be carried out on a patient. Establishing this trust requires both parties to recognize the necessity of communicating freely and honestly thereby facilitating a mutually beneficial pact. This pact is formalized in the requirement for an individual's consent, which, to be valid, must be given voluntarily by a competent and well informed patient. The purpose of this consent is firstly to provide a legal justification for a doctor's duty of care towards the patient, thereby allowing touching of another person in a therapeutic context. This legal construct avoids committing the tort of battery and needing to defend this criminal charge. Secondly, obtaining consent upholds the ethical principle of autonomy and a doctor's legal duty to inform, thus avoiding a charge of negligence by the patient from lack of appropriate information.

If general anesthesia with an endotracheal tube (ETT) is chosen, attention must be paid to airway management, infection, and intraoperative ventilation [17]. As a result of chronic steroid therapy with resultant diabetes, patients following solid organ transplantation acquire morphologic features that increase the risk for unplanned difficult airway management. A thorough airway examination should occur in all patients, but it is especially important in this patient population with known increased risk of difficult airway and gastric atony. Proper placement of the ETT is vitally important to avoid possible airway trauma or damage to the bronchial anastomosis. In terms of the route of intubation, orotracheal intubation is certainly preferred over nasal intubation to avoid possible contamination from local microorganisms.

Mechanical ventilation is a procedure often performed in patients in the emergency department (ED) who present in respiratory distress [18]. The indications of mechanical ventilation include airway protection, treatment of hypoxemic respiratory failure, treatment of hypercapnic respiratory failure, or treatment of a combined hypoxic and hypercapnic respiratory failure. On some occasions, patients are also intubated and placed on mechanical ventilation for emergent procedures in the ED, such as the traumatically injured and combative patient who needs emergent imaging. However, intubation and initiation of mechanical ventilation requires a great degree of vigilance, as committing to this therapy can affect the patient's overall course.

Traditionally, mechanical ventilation has not been taught as a core component of Emergency Medicine practice, instead, principles of ventilation have been left to intensivists and respiratory therapists. However, with increasing boarding times in the ED and increased acuity of our patients, emergency physicians are frequently caring for mechanically ventilated patients for longer and longer periods of time. Additionally, the data supporting the importance of good ventilator management in all critically ill patients continues to increase.

Conclusion

Airway care and ventilation of emergency patients in prehospital settings often takes place in unpredictable and unfavorable environments due to the terrain, lighting, weather and even hostile behavior, and as such, is a huge challenge in the work of an emergency medical team. Appropriate assessment and care of the respiratory tract and effective ventilation are essential procedures and basic assumptions in the quality care of emergency patients, given their location and severity of injuries. Without protecting the airway from obstruction and reducing the risk of aspiration and hypoxia, all other procedures will be with almost no benefit.

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