

## Pulmonary Aspiration During Extubation

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### Introduction

Pulmonary aspiration is the inhalation of oropharyngeal or gastric contents into the larynx and the respiratory tract. Mendelson described the potential consequences of abolished airway reflexes under anaesthesia and the subsequent aspiration of gastric contents, known as Mendelson's syndrome. Pulmonary aspiration occurs 1 in 900 to 1 in 10000 cases of general anaesthesia administered. Mortality rate of patients who had aspiration ranges from 0 to 4.6%. The incidence of aspiration under anaesthesia is greater with higher ASA status and emergency surgery.

Prevention of pulmonary aspiration is one of the main goals of anaesthetic practice. Problems associated with extubation is often more common than those occurring at intubation. Aspiration of solid matter can cause hypoxia by physical obstruction, whereas aspiration of acidic gastric fluid can cause pneumonitis with progressive dyspnoea, hypoxia, wheeze, patchy collapse with consolidation in the chest radiograph. The risk of morbidity and mortality increases with bronchial exposure to greater volumes and acidity of the aspirated material.

### Mechanism to prevent pulmonary aspiration

The gastro-oesophageal junction, upper oesophageal sphincter, and protective laryngeal reflexes are the physiological mechanisms to prevent aspiration, which are attenuated during general anaesthesia. The acute angle between the oesophagus and stomach assists the lower oesophageal sphincter (LOS) in protecting the oesophagus from gastric acid reflux. Reinforced by crura of the diaphragm, LOS resting pressure exceeds gastric pressure creating a physiological barrier to gastro-oesophageal reflux, known as the barrier pressure. During general anaesthesia, reflux may occur because this barrier pressure is reduced by the relaxation of the LOS caused by drugs such as anticholinergics, opioids, and anaesthetic agents.

Reflux of gastric contents into the oesophagus occurs in both healthy individuals and those with gastro-oesophageal reflux disease (GORD) when the LOS transiently relaxes in the absence of swallowing. Protective upper airway reflexes like cough and laryngospasm are attenuated by reduced levels of consciousness including emergence

from general anaesthesia. Elderly patients are particularly prone to aspiration as they have less active airway reflexes.

Most anaesthetic techniques attenuate the protective physiological mechanisms that prevent regurgitation and aspiration. Inadequate depth of anaesthesia or unexpected responses to surgical stimulation may evoke gastrointestinal motor responses, such as gagging or recurrent swallowing, increasing gastric pressure above LOS pressure facilitating reflux. This can extend to varied extent during extubation and recovery period.

### Risk factors for pulmonary aspiration

*Patient factors:* Full stomach (Emergency surgery, inadequate fasting time, gastrointestinal obstruction), delayed gastric emptying (diabetes mellitus, chronic kidney disease, trauma, opioids, pregnancy, morbid obesity), higher ASA status.  
*Surgical factors:* Upper gastrointestinal surgery, lithotomy or head down position, laparoscopy.  
*Anaesthetic factors:* Light anesthesia, supra-glottic airways, positive pressure ventilation, difficult airway, airway device (First generation supraglottic device).

Pathology of the gastrointestinal tract delays gastric emptying, and impairs the function of the LOS. These effects are compounded in emergency surgery and lithotomy position. In pregnancy, the gravid uterus displaces the stomach, altering the angle between the oesophagus and stomach. This is exacerbated by maternal obesity, multiple pregnancy, and polyhydramnios. Higher concentrations of progesterone reduce barrier pressure further by relaxing the LOS, whilst decreased concentrations of the peptide hormone motilin delays gastric emptying.

### Process of extubation

An unprotected airway, light depth of anaesthesia, and other predisposing risk factors for aspiration significantly increase the risks of aspiration. When deciding to extubate one must consider

- was there any difficulty in controlling the airway?
- what is the risk of pulmonary aspiration?

### Preparation for extubation

This includes recovery from neuromuscular blockade, hemodynamic stability, normothermia

and adequate analgesia. Ventilation with 100% oxygen and alveolar recruitment maneuvers should be considered in appropriate cases. Pharyngeal and tracheal suctioning, removal of throat pack and placement of bite block if needed should be done in deep plane of anaesthesia. A bite-block often ensures a secure airway through the tracheal tube during emergence. Oropharyngeal airways are not recommended as bite blocks as they can cause dental damage. Instead a rolled gauze may be inserted between the molars. Alternatively, the tracheal tube may be left *in situ* with cuff deflated, so that patients can breathe around it if the tube is bitten during emergence. A nasal tracheal tube withdrawn to the nasopharynx can be used as a nasal airway during emergence. Gastric insufflations can increase the risk of pulmonary aspiration after extubation and can impede with ventilation. If needed, orogastric tube may be used to deflate the stomach before extubation. Application of positive pressure just before cuff deflation can help to expel the secretions collected above the endotracheal tube cuff. Inspection of the pilot balloon for cuff deflation is necessary to prevent vocal cord trauma during extubation. Before extubation, everything should be ready for emergency reintubation in case the situation demands.

#### **Awake versus deep extubation**

The decision should be taken weighing the risks and benefits of the individual scenario. Awake patient is able to maintain a patent airway without aspiration due to the pharyngeal muscle tone and airway reflexes. Extubation under deep anaesthesia decreases cardiovascular stimulation and reduces the incidence of coughing and straining on the tube, but has the risk of hypoventilation and pulmonary aspiration if regurgitation of gastric content or vomiting occurs. Children show greater incidence of upper airway complications with awake extubation due to increased airway reactivity. In children, extubation in the recovery position while still anaesthetized is a common practice.

#### **Position at extubation**

The sniffing position is the standard for extubation, as the patient is optimally positioned for airway management. Extubating in left lateral, head-down position can be used in those with high risk for aspiration as it maintains airway patency by keeping the tongue away from the posterior pharyngeal wall. Laryngoscopy and reintubation is easy in this position for the experienced anaesthesiologists. Extubation in supine position provides the relative ease of reintubation in this position. A semi-upright position facilitates spontaneous respiration and diaphragmatic expansion, aids in effective cough reflex, increases functional residual capacity (FRC) and encourages lymphatic drainage and reduction

of airway oedema. Recent practice guidelines for patients with obstructive sleep apnoea recommend semi-upright, lateral or any non-supine position for extubation and recovery. Extubation in prone position may be necessary after some procedures like spinal surgery. After reversal of neuromuscular block, spontaneous regular ventilation has to be achieved after which anaesthesia is discontinued and extubation performed with eyes open or on purposeful movements.

#### **Timing of extubation**

Extubation is usually carried out at end-inspiration when the glottis is fully open to prevent trauma and laryngospasm. Direct laryngoscopy, suctioning of the posterior pharynx, administration of 100% oxygen, ventilation to aid washout of inhalation agents, and positive pressure breath at extubation to prevent atelectasis are routine manoeuvres before extubation.

#### **Management of aspiration**

This is directed to supportive treatment and organ support. Anaesthesiologist should have a high index of suspicion to recognize aspiration should it occur. Trachea should be suctioned once the airway is secure, ideally before positive pressure ventilation to prevent the distal displacement of aspirated material. Aspiration will more commonly affect the right lung because the right main bronchus is more vertical than the left. Early chest radiograph will show consolidation in up to 75% of cases and early bronchoscopy may help prevent distal atelectasis if particulate matter has been aspirated. Aspiration may lead chemical pneumonitis, bacterial pneumonia, or adult respiratory distress syndrome requiring mechanical ventilation. Antibiotics should only be used if pneumonia develops. There is no evidence that steroids reduces mortality or improves outcome.

#### **Conclusion**

The process of extubation is a critical part of airway management. Although emphasis is usually on the problems encountered during intubation, potential life threatening complications can occur during extubation. Prevention of pulmonary aspiration and timely recognition of risk factors with prompt management of aspiration if it occurs is needed for a safe anaesthetic outcome.

#### **References**

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