

Gastro-oesophageal Reflux: What's the Big Deal?

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Gastro-oesophageal reflux (GOR) remains a concern for the anaesthetist because aspiration pneumonitis carries the potential for significant morbidity and mortality. Reflux is probably common, whilst aspiration during the peri-operative period is rare, and aspiration pneumonitis is exceedingly rare.

Background

General anaesthesia may predispose patients to aspiration of gastroesophageal contents because of depression of protective reflexes during loss of consciousness.¹ Some patients may be at increased risk of pulmonary aspiration because of retention of gastric contents caused by pain, inadequate starvation, or gastrointestinal pathology resulting in reduced gastric emptying and gastroesophageal reflux. The prevalence of aspiration in elective surgery is about one in three thousand anaesthetics and aspiration causes one death per 200,000 elective anaesthetics.^{1,2,3}

History

The effects of aspiration of food and drink had been known since the time of Hippocrates, but it was John Hunter who performed the first scientific experiments investigating the pathophysiology of aspiration in 1781. The first documented death related to anaesthesia was most likely a result of the liquid administered during unconsciousness. In this case, Sir James Simpson identified pulmonary aspiration of the brandy and water that Hannah Greener, a 15-year-old girl, was given during chloroform anaesthesia since "her lips, which had been previously of good colour, became suddenly blanched, and sputtered slightly at the mouth as one with epilepsy."

John Snow's book "On Chloroform and other Anaesthetics" was published in 1858.⁴ He comments regarding regurgitation and demonstrates concern about vomiting rather than aspiration:

"The only direction which is usually requisite to give beforehand, to the patient who is to inhale chloroform, is to avoid taking a meal previous to the inhalation; for chloroform is very apt to cause vomiting, if inhaled whilst there is a quantity of food in the stomach. The sickness is not attended with any danger, but it constitutes an unpleasantness and inconvenience, which it is desirable to avoid. The best time of all for an operation under chloroform is before breakfast, but the customs and

arrangements of this country do not often admit of that time being chosen, and it is unadvisable to make the patient fast beyond his usual hour. The most usual time for vomiting to commence is when the inhalation has been discontinued, and the effects of the chloroform are passing off. In many cases, it occurs before the patient has become quite conscious, and he does not know that it has occurred unless told. In a few cases, especially where there is a good deal of food in the stomach, the vomiting comes on before the operation is finished, or even before it is commenced. When vomiting comes on during an operation, it is apt to interfere with the inhalation, and it is difficult sometimes to prevent the patient from waking."

The dangers of regurgitation and aspiration seem to have been ignored at this early stage. GOR and vomiting were considered messy, a nuisance and interfering with the administration of anaesthesia. In the past, teaching on anaesthesia was usually in surgical texts. One such example was "A Manual of Surgical Treatment" published in 1912;⁵ in this text recommended preoperative preparation included, "A purge of castor oil, compound liquorice powder, calomel, colocynth or compound rhubarb pill the night before operation and, if necessary, an enema on the morning of surgery." With regards to diet, the author wrote, "It is important that the stomach should be empty before the inhalation commences; but starvation may be carried too far, especially in the feeble." He added, "The best time for operating is the early morning, in which case no food need be given after supper on the previous evening. If the operation be fixed for the afternoon, a light breakfast should be taken not later than 8 am, and a cup of hot broth or beef tea, or even hot water alone, should be given not less than three hours before the actual time of operation."

The publication in 1946 of Mendelson's paper entitled "The aspiration of stomach contents into the lungs during obstetric anaesthesia", began a new era in our understanding of regurgitation and aspiration.⁶ Mendelson's data included 44016 unfasted parturients who received ether anaesthesia for delivery and operations associated with delivery. There were 66 cases of aspiration (0.15%) and two deaths from complete airway obstruction caused by large food particles. No patients died from aspiration pneumonitis despite cricoid pressure (Sellick's manoeuvre) not being utilised at this stage. Mendelson established the role of low pH of gastric secretions as an important mechanism involved in lung injury associated with aspiration. He described the changes that occurred as a result of gastric aspiration as well as the clinical symptoms. Based on these findings, recommendations for prevention and treatment of aspiration of gastric contents were proposed. These included: "withholding oral feeding during labour and substituting parental administration, wider use of local anaesthesia where feasible and alkalinisation of and emptying the stomach."

In 1961 there was another important publication in the *Lancet* by Brian Sellick from the Middlesex Hospital in London.⁷ Sellick wrote, "When the contents of the stomach or oesophagus gain access to the air passages during anaesthesia, the consequences are disastrous. In spite of modern anaesthetic techniques, or sometimes regrettably because of them, regurgitation is still a considerable hazard during induction of anaesthesia, particularly for operative obstetrics and emergency general surgery. Cricoid pressure must be exerted by an assistant. Before induction, the cricoid is palpated and lightly held between the thumb and second finger; as anaesthesia begins, pressure is exerted on the cricoid cartilage mainly by the index finger. Even a conscious patient can tolerate moderate pressure without discomfort but as soon as consciousness is lost, firm pressure can be applied without obstruction of the patient's airway."

Pressure is maintained until intubation and inflation of the cuff of the endotracheal tube is complete.”

Sellick was aware that cricoid pressure could not be relied on totally.

Gastro-oesophageal reflux

The stomach contracts every 20 seconds with pressure increases to as much as 50 cm H₂O; it can accommodate up to 1500 ml. Fasted patients may have 200 ml of gastric fluid. The lower oesophageal sphincter (LES) is competent to about 30 cm H₂O if normal. The difference between LES pressure and gastric pressure is the “barrier pressure” (BaP). Anaesthesia tends to decrease BaP and reduce protective reflexes, thus increasing the risk of GOR.^{1,8}

Various drugs decrease LES tone, including anticholinergics, thiopentone, opioids and volatile anaesthetics. Drugs increasing LES tone include antiemetics, cholinergics, succinylcholine and antacids, whilst non-depolarising muscle relaxants and histamine 2 receptor (H₂R) blockers have no effect on the LES tone.¹ Contrary to common belief, there is poor correlation between Body Mass Index (BMI), smoking, duration of fasting, alcohol consumption, gastric pH and gastric volume with GOR. However, pregnancy, ascites, obesity, gastrointestinal distension, acute pain, opioids, anxiety, trauma and active labour, delay gastric emptying increasing the probability of GOR.^{1,3,8}

Morbidity and mortality with aspiration

The AIMS study published in 1999, included 133 cases of aspiration in 5000 incident reports.⁹ Most patients had at least one predisposing factor for regurgitation, vomiting or aspiration. There were five deaths, all in high-risk patients (two ASA 3, two ASA 4 and one ASA 5). These results compare with other series that show a mortality rate of about 4% from aspiration, and that death from aspiration occurs in high-risk patients.¹⁻³ The airways present at the time of aspiration were ETT,⁸ Hudson mask,⁵ LMA²⁷ and Face Mask⁹. Amongst the patients aspirating, 20% were under 14 years; aspiration in the 0 to 9 year age group was three times that in the 20 to 49 year old group.⁹ Most patients have prolonged hospital stay, or ICU admission with varying levels of respiratory support.

Methods to minimise reflux and aspiration

Minimise gastric content

Gastric content may be reduced by appropriate fasting, pre-operative emptying of the stomach (in selected cases using a gastric tube), pro-kinetic agents, and by inhibiting gastric secretion. Metoclopramide is an effective pro-kinetic agent, which acts centrally and peripherally to increase gastric peristalsis, increase LES tone and relax the pylorus.⁸ Intravenous metoclopramide (10-20 mg) decreases gastric volume, without any effect on gastric pH within 30 minutes; the effect persists for about three hours.^{8,10}

Minimising GOR

The hazards of GOR may be minimised by reducing gastric content, using a pro-kinetic agent or cricoid pressure (CP). There is debate regarding the efficacy of CP arising from a lack of convincing evidence for a reduced incidence of aspiration or mortality. However, this reflects both relatively few studies and the infrequency of aspiration, rather than ineffectiveness of CP. Effective CP does reduce passive

regurgitation of gastric contents to the laryngopharynx and should therefore continue to be used in all cases where there is a significant risk of regurgitation or aspiration.

Prevention of pulmonary aspiration

Aspiration of regurgitated gastric material is nearly always prevented by CP and by securing the airway. Tracheal intubation with a cuffed tube offers most protection, but is imperfect. High volume/low-pressure cuffs are most effective for sealing the airway, but leaks can still occur around the cuff.¹ Awake endotracheal intubation may be indicated when there is high regurgitation risk combined with an anticipated difficult intubation.

Hiatus hernia

Hiatus Hernia (HH) can be viewed as a progressive disruption of the oesophago-gastric-junction. The LES tone is the major component of the anti-reflux barrier. Anything disrupting the LES will increase GOR. The larger the hiatus hernias, the greater the risk of GOR in both adults and children.¹¹ HH is common and estimates of prevalence vary from 10 to 80% of the adult population in North America. In most patients, HH is asymptomatic and there is poor correlation between HH and GOR. The safest approach is to treat all patients with symptomatic HH as at risk for GOR. Management of patients with asymptomatic HH is controversial. Patients with asymptomatic HH who do not have other risk factors for GOR, do not need any specific anti-reflux therapy.

Pathogenesis of lung injury following aspiration

Lung injury may result from particulate, acid and bacterial soiling of the lung. Extrapolation from rhesus monkey studies led to the now much-debated conclusion that gastric volume greater than 25 ml (or 0.4 ml/kg) and pH less than 2.5 worsens outcome from aspiration.¹² There are no data to show improved outcome after aspiration following the prophylactic use of antacids, H₂R blockers, PPIs or prokinetics. Therefore, when considering that there is about one death per 200,000 anaesthetics from aspiration, it seems that the routine use of antacid/prokinetic therapies is not justified.⁸

Prophylaxis against acid aspiration

H₂R blockers and PPIs are effective at reducing secretion of gastric acid. H₂R blockers have been shown to be more effective compared with PPIs.¹³ A single oral dose of ranitidine or famotidine three hours before surgery provides more effective volume and pH control of gastric secretion than omeprazole.

Particulate antacids should never be used because the particles can cause a pneumonitis.¹⁴ Non-particulate antacids such as 30 ml of 0.3 M sodium citrate are effective at increasing gastric pH to greater than 2.5 in most patients within a few minutes and continue to be effective for up to three hours. Antacids have no significant effect on gastric volume.

Pro-kinetics may be useful for reducing gastric volume prior to induction.

Management of aspiration once it has occurred

Useful measures include bronchoscopy, suction, physiotherapy, specific antibiotics for established infection, supportive treatments including supplemental oxygen,

respiratory support, monitoring in a high dependency environment and bronchodilators, if indicated.¹ Broad-spectrum antibiotics and prophylactic steroids have not been shown to improve morbidity or mortality. Lavage should only be used if particulate material is aspirated. Lavage extends acidic fluid deeper into bronchial tree, worsening outcome.⁸

Laryngeal mask airway

The effect of the LMA on barrier pressure and LES tone is a subject of controversy. The LMA probably reduces BaP at the LES. Based on pH probe measurements, patients probably regurgitate to the lower oesophagus more often with spontaneous or positive pressure ventilation (PPV) using a LMA compared with a facemask.¹⁵ The Classic LMA does not protect the airway if regurgitation to the proximal oesophagus occurs. The Pro-seal LMA may provide better airway protection.

In 1995, Brimacombe and Berry published a meta-analysis detailing 12,901 uses of the LMA.¹⁶ There were three episodes of pulmonary aspiration giving a prevalence of 1 in 4000. Generally, cases had one or more predisposing factors. There was no permanent disability or death.

LMA and Caesarean Section

The LMA has been used safely for elective Caesarean section in one prospective study of 1067 cases.¹⁷ In this study, all patients were fasted and given ranitidine and sodium citrate. A rapid sequence induction was performed with thiopentone and suxamethonium. Cricoid pressure was maintained until delivery, but was relaxed if insertion or ventilation was difficult. An effective airway was obtained in 1060 (99%) patients, 1051 (98%) at the first attempt and nine (1%) at the second or third attempt. There were no episodes of hypoxia ($\text{SpO}_2 < 90\%$), aspiration, regurgitation, laryngospasm, bronchospasm or gastric insufflation. In this study, the LMA was both safe and effective, even though such use is unorthodox. The report offers reassurance that, in the event of a failed intubation, the LMA makes an adequate second line airway.

Proseal LMA (PLMA)

Does the PLMA airway prevent aspiration of regurgitated fluid?

The PLMA has a drainage tube, which directs regurgitated fluid away from the laryngeal inlet. The drainage tube also allows the passage of a gastric tube, which can be utilised to decrease gastric volume. In a cadaver model, a correctly placed PLMA allows fluid in the oesophagus to bypass the pharynx and mouth, when the drainage tube is open. The PLMA provides about twice the seal at 40 ml cuff volume compared with the Classic LMA.¹⁸

The place of the PLMA is yet to be established. On the evidence to hand, the PLMA may provide more airway protection in situations of moderate to high GOR risk compared with the Classic LMA. It may be suitable for routine use in patients with mild to moderate GOR. Where there is failed endotracheal intubation in a situation of high GOR risk, the PLMA (with or without a gastric tube) is likely to provide a greater margin of safety when compared with the Classic LMA.

Conclusion

GOR remains a concern for the anaesthetist. It is common, probably happening more often than we realise. Pulmonary aspiration of gastric contents is fortunately a

rare event, yet carries significant risk of morbidity and mortality, particularly in high-risk patients. The role of the LMA, particularly the PLMA in patients who are at increased risk for GOR is yet to be resolved.

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