

Gastro-oesophageal reflux disease (GORD) – To tube or not?

Lasersohn L, MBBCh(Wits), DA(SA), FCA(SA), Crit Care(SA)
Private Practice, Johannesburg

Correspondence to: Dr Lance Lasersohn, e-mail: Lance@globalmicro.co.za

SAJAA 2009; 15(3): 13-18

Introduction

Gastro-oesophageal reflux disease (GORD) is the most common gastrointestinal diagnosis recorded during visits to outpatient clinics.¹ In the United States, it is estimated that 14 to 20% of adults are affected. This figure may, however, correlate to an overestimation of the disease prevalence. The disease having a nebulous definition, is based on self-reported chronic heartburn and it has been shown that only symptoms of moderate intensity occurring at least once a week have a significant impact on quality of life.²

A current definition of the disorder is a “condition which develops when the reflux of stomach contents causes troublesome symptoms (i.e. at least two heartburn episodes per week) and/or complications.”³

It is caused by the retrograde passage of gastric (or gastroduodenal) contents through the cardia into the oesophagus. From a clinical

standpoint, the term ‘GORD’ encompasses all individuals who are at risk of physical complications as a result of exposure to gastro-oesophageal reflux or who experience a clinically significant impairment of health-related wellbeing due to reflux-related symptoms (following adequate reassurance of their benign nature).⁴

Gastro-oesophageal reflux, anaesthesia and pulmonary aspiration

In order to identify patients presenting for anaesthesia that are at risk for gastro-oesophageal reflux and who may be classified as having GORD, it is important to be aware of and extract the symptoms and conditions associated with GORD at the time of the pre-anaesthetic assessment.

These are listed below in Table I.

Table I: Symptoms and conditions associated with gastro-oesophageal reflux disease⁵

Oesophageal syndromes
<p><i>Injury (with or without oesophageal symptoms)</i></p> <p>Reflux oesophagitis: necrosis of oesophageal epithelium causing erosions or ulcers at or immediately above the gastro-oesophageal junction</p> <p>Stricture: a persistent luminal narrowing of the oesophagus caused by reflux-induced inflammation</p> <p>Barrett’s oesophagus: endoscopically suspected and histologically confirmed metaplasia in the distal oesophagus, usually with the added stipulation that it be specialised intestinal metaplasia</p> <p>Oesophageal adenocarcinoma</p> <p><i>Symptoms with or without oesophageal injury</i></p> <p>Common symptoms: heartburn, regurgitation, dysphagia, chest pain</p> <p>Less common symptoms: odynophagia (pain with swallowing), water brash (excessive salivation prompted by acid reflux), subxiphoid pain, nausea</p>
Extra-oesophageal syndromes
<p><i>Association with gastro-oesophageal reflux disease established but good evidence for causation only when accompanied by an oesophageal syndrome</i></p> <p>Chronic cough</p> <p>Laryngitis (hoarseness, throat clearing): reflux usually a cofactor along with excessive use of the voice, environmental irritants, and smoking</p> <p>Asthma (reflux as a cofactor leading to poorly controlled disease)</p> <p>Erosion of dental enamel</p> <p><i>Proposed association with gastro-oesophageal reflux disease but neither association nor causation established</i></p> <p>Pharyngitis</p> <p>Sinusitis</p> <p>Recurrent otitis media</p> <p>Idiopathic pulmonary fibrosis</p>

The immediate and most apparent risk associated with anaesthesia and GORD is pulmonary aspiration in the peri-operative period. In the general population, pulmonary aspiration during this period is relatively infrequent and there has been little change with respect to its incidence in the last few years.

Factors that contribute to the likelihood of aspiration include⁶:

- The urgency of surgery
- Airway problems
- Inadequate depth of anaesthesia
- Use of the lithotomy position
- Gastrointestinal problems
- Depressed consciousness
- Increased severity of illness and
- Obesity

Morbidity and mortality attributable to aspiration

The morbidity attributable to aspiration has been assessed by examination of the presence of pulmonary infiltrates on chest radiography, the necessity for the use of antibiotics or bronchodilators, and the duration of respiratory support required after aspiration.⁶

In many studies there are no deaths attributable to aspiration. In the Australian Incident Monitoring Study, the mortality in patients who aspirated was 3.8%.⁷ The incidence in a study from 1985 to 1991 out of the Mayo Clinic, the mortality was 4.5%,⁸ which values compare well with a mortality of 4.6% in Sweden.⁹

Preventing aspiration – physiological mechanisms

The physiological mechanisms that prevent regurgitation and aspiration include the lower oesophageal sphincter (LOS), the upper oesophageal sphincter (UOS), and the laryngeal reflexes.

The LOS

The LOS forms the border between the stomach and the oesophagus. A reduction in LOS pressure, in most cases due to transient relaxation of the LOS, is the major physiological derangement in patients with gastro-oesophageal reflux during anaesthesia and in disease states. The tendency to regurgitation is dependent on the difference between LOS pressure and gastric pressure – this difference is termed the “barrier pressure”.⁶

Anaesthetics and techniques may reduce LOS pressure and therefore promote reflux because of a reduction in barrier pressure.¹⁰ Techniques such as insertion of nasogastric tubes (mechanical), application of cricoid pressure and insertion of laryngeal mask airways decrease LOS tone¹¹ during their application (which suggests mechanoreceptors in the pharynx

may mediate relaxation of the LOS). Table II summarises the effects of drugs on LOS tone.

A typical anaesthetic is likely to be associated with a reduction in barrier pressure and therefore increased tendency to regurgitation.

The UOS

The cricopharyngeus muscle acts as the functional UOS. In healthy conscious volunteers, the UOS helps prevent aspiration by sealing off the upper oesophagus from the hypopharynx. There is evidence to suggest that its function is impaired during normal sleep and anaesthesia.¹³

With the exception of ketamine, most anaesthetic techniques are likely to reduce UOS tone and increase the likelihood of regurgitation of material from the oesophagus into the hypopharynx.

In addition, patients who have received neuromuscular blocking drugs may be at risk of aspiration, even with a TOF of > 0.7, because of a reduction of UOS tone and impaired swallowing. Multiple regression analysis in a 1997 study¹⁴ demonstrated that increasing age, anaesthetics longer than 200 minutes, and abdominal surgery were associated with increased risk of postoperative pulmonary complications.

Protective airway reflexes

Four well-defined reflexes have been described in the upper airway⁶:

- Apnoea with laryngospasm
- Coughing
- Expiration – forceful expiratory effort without an inspiration
- Spasmodic panting – shallow breathing at 60 breaths/minute for < 10 secs.

It has been found that the expiration reflex is the most common protective reflex elicited.

Unconscious patients are therefore at risk of aspiration because of impaired airway reflexes. These protective reflexes may be impaired at any stage in the peri-operative period. There is a progressive decrease in upper airway reflex sensitivity with increasing age.¹⁵ Two hours after recovery from general anaesthesia for day case surgery, upper airway reflex sensitivity had not returned to baseline values in a 2000 study. However, auditory reaction time, a measure of recovery from anaesthesia had returned to normal at this time and patients were allowed to go home.¹⁶ It seems therefore that patients may have reduced

airway reflex sensitivity, not only during the intraoperative, but also the postoperative period, perhaps for longer than estimated from objective tests in recovery. The elderly should therefore be considered to be at increased risk of aspirating pharyngeal material in this regard.⁶

Methods to minimise regurgitation and aspiration

Methods that may be utilised to minimise aspiration and its morbidity include control of gastric contents and reduction in gastro-oesophageal reflux. This involves preoperative starvation, a decrease in gastric acidity using H2 antagonists or PPIs, facilitation

Table II: Effects of drugs used in anaesthesia on lower oesophageal sphincter tone^{10,12}

Increase	Decrease	No change
Metoclopramide	Atropine	Propranolol
Domperidone	Glycopyrrolate	Oxprenolol
Prochlorperazine	Dopamine	Cimetidine
Cyclizine	Sodium nitroprusside	Ranitidine
Edrophonium	Ganglion blockers	Atracurium
Neostigmine	Thiopental	?Nitrous oxide
Succinylcholine	Tricyclic antidepressants	
Pancuronium	β adrenergic stimulants	
Metoprolol	Halothane	
α adrenergic stimulants	Enflurane	
Antacids	Opioids	
	?Nitrous oxide	
	Propofol	

of gastric drainage and maintenance of a competent lower oesophageal sphincter. Further methods include the prevention of pulmonary aspiration and attenuation of the effects of aspiration. These two factors may require endotracheal intubation or the use of other airway devices and application of cricoid pressure.^{6,17}

Why not intubate everyone for anaesthesia?

The question has to be raised – with evidence suggesting that airway reflexes are delayed for many hours post-operatively, that gastro-oesophageal reflux is common in the general population, and the difficulty in establishing the presence and severity of gastro-oesophageal reflux at the pre-anaesthetic assessment, why not use endotracheal tubes as the standard for providing airway protection and control for the majority of anaesthetics?

The reasons for not doing this are two-fold:

1. *The incidence of pulmonary aspiration, despite all the presented data, remains relatively rare.* Reported incidences vary from 0.7 to 4.7 per 10 000 general anaesthetics in a 1986 Scandinavian study⁹ to 2.9 per 10 000 in Norwegian hospital study 10 years later.¹⁷ Studies from the Mayo clinic indicated that the incidence of aspiration is similar in adults (3.1 per 10 000)¹⁸ and children (3.8 per 10 000).¹⁹ It is generally accepted that obstetric anaesthesia is a high-risk area for aspiration and that severe morbidity and mortality as a result of aspiration in this population subset is likely to be more frequent. However, a study published in 2000 from Israel, in peripartum patients (excluding Caesarean sections) between 1979 and 1993, demonstrated only one case of aspiration in 1870 general anaesthetics. This despite the fact that these anaesthetics were all delivered via face-mask.²⁰
2. *Endotracheal intubation is not without its own risks and complications.* Mechanical complications such as dental injury, sore throat and vocal cord paralysis, tracheal epithelial inflammation and ischaemia to the tracheal wall as well as other pharmacological and physiological factors such as the higher likelihood of requirement for the use of muscle relaxation with its attendant side-effects and complications, increased incidence of postoperative nausea and vomiting (PONV) and postoperative pain²¹ in some studies related to endotracheal intubation, airway irritability and haemodynamic responses – all of which may lead to unwanted complications of their own. These risks/complications coupled with the fact that regurgitation and pulmonary aspiration may also occur, even with a correctly positioned endotracheal tube (ETT) (leakage around unlubricated cuffs has been quoted as high as 83%²²), makes extraglottic airways (EGA) an attractive and viable alternative.

Which airway for anaesthesia?

An appropriate approach would be to select an appropriate airway device to provide secure ventilation and oxygenation while causing minimum airway morbidity and keeping the risk of aspiration to a minimum.

It is clear when endotracheal intubation is the requirement and other options are to be utilised as a second choice for reasons such as failed intubation. These include:

- Emergency surgery and the “full stomach”
- Requirement for prolonged ventilation or airway protection postoperatively (e.g. critically injured patients, likely prolonged depressed level of consciousness)
- Requirement for high ventilatory pressures (decreased lung/chest compliance)
- Surgery that requires lung isolation, tracheal suctioning or

tracheo-bronchial toilet

- Cardio-pulmonary resuscitation

If these indications are absent, extraglottic airways may be considered and are more often utilized to avoid the complications and risks and side-effects of endotracheal intubation.

GORD – To tube or not to tube?

GORD does not appear in the list above as an absolute indication for intubation.

As noted earlier, the disease itself has a nebulous definition, where a patient labelled with GORD may have no proximal reflux of gastric content at all. Various trials with the “Classic LMA™” have shown possible effects on lower oesophageal tone and argued that this increases the risk of gastro-oesophageal reflux.¹¹ However, the evidence from published clinical trials suggests that this is not an issue.²³ Increasing confidence of anaesthetists in the safety of extraglottic airways is leading to the expansion of their use into patients with a history of, or at risk of gastro-oesophageal reflux.²⁴ There are no published trials to support this development.

Since the introduction of the original or classic laryngeal mask airway nearly 20 years ago, a vast array of extraglottic airway (supraglottic airway) devices have been developed. Current devices include at least 20 single-use and reusable laryngeal masks and five variations of reusable and single-use flexible laryngeal masks.²⁵ It has been calculated that in 2003, an estimated £8 million was spent on these devices in the UK alone.²³

These devices may be classified according to their sealing mechanism as shown in Table III.

In the opinion of the author, a rational approach to selecting or eliminating patients that have been labelled as having GORD, may be divided as follows:

1. Good “reflux” history and pre-anaesthetic assessment
2. Surgical and anaesthetic plan
3. Anaesthetic considerations

Reflux history

Common symptoms (oesophageal syndrome) of gastro-oesophageal reflux (refer table 1) and reflux medications should be sought in every pre-anaesthetic assessment. Chronic cough, laryngitis, asthma or erosion of dental enamel may be associated with the oesophageal syndrome of GORD. Once a diagnosis of GORD is established, an attempt to grade the severity of GORD should follow. Indications of severe symptomatic GORD include any of the extra-oesophageal syndromes as well as reflux that occurs often on lying flat or a sensation of choking and being woken from sleep.

Surgical and anaesthetic plan

As opposed to the normal healthy population without an increased risk of gastro-oesophageal reflux and therefore aspiration (around 4 per 10 000), patients with GORD are going to be at increased risk for aspiration. The following should be taken into consideration before deciding on whether an extraglottic device may be appropriate:

- *Surgical position* – any surgical position that would compromise easy and immediate access to the patient’s airway should mandate endotracheal intubation. Easy and continuous monitoring of the airway device should be a requirement for using an extraglottic airway when suspicion of GORD is present.

Table III: Classification of extra/supraglottic airway devices^{25,26}

Classification based on sealing mechanism		
<p>A. Cuffed perilaryngeal sealers</p> <p>Nondirectional sealing</p> <ul style="list-style-type: none"> Reusable: <ul style="list-style-type: none"> Laryngeal mask airway (cLMA) Intubating laryngeal mask (ILMA) Intavent Orthofix, Maidenhead (UK) Single use: <ul style="list-style-type: none"> LMA-Unique (Intavent Orthofix, Maidenhead, UK) SoftSeal Laryngeal Mask <p>Directional sealing</p> <ul style="list-style-type: none"> Reusable: <ul style="list-style-type: none"> ProSeal LMA (Intavent Orthofix, Maidenhead, UK) 	<p>B. Cuffed laryngeal sealers</p> <p>Without oesophageal sealing</p> <ul style="list-style-type: none"> Single use: <ul style="list-style-type: none"> Cobra PLA Paxpress <p>With oesophageal sealing</p> <ul style="list-style-type: none"> Reusable: <ul style="list-style-type: none"> Laryngeal Tube Sonda Airway Management Device (Nagor Ltd, Douglas, Isle of Man) Single use: <ul style="list-style-type: none"> Combitude 	<p>C. Cuffless anatomically preshaped sealer</p> <ul style="list-style-type: none"> Single use: <ul style="list-style-type: none"> SLIPA

- *Increased reflux possibility* – emergent surgery, anticipated airway problems, the use of lithotomy position, gastrointestinal problems (e.g. bowel obstruction, acute abdomen), increased severity of illness and morbid obesity (BMI > 35) are factors that are likely to exclude patients from the possibility of anaesthesia with the use of extraglottic airways.
- *User experience* – Anaesthetists with limited experience with extraglottic devices or, in particular users with limited experience with directional sealing devices such as the ProSeal™ LMA or LMA Supreme™ which have separate tracts for the airway and gastrointestinal tract should avoid the use of extraglottic devices with a patient with a positive history of GORD.
- *Indications for endotracheal intubation* – would exclude the possibility of using supra/extraglottic devices.

Anaesthetic considerations

Pre-anaesthetic assessment and premedication

For patients with a positive history for GORD, methods to minimise regurgitation and aspiration should be employed.

- *Pre-operative starvation* according to accepted standard guidelines is essential. Altered physiological states such as pregnancy, gastrointestinal disorders and diabetes mellitus are associated with alterations and prolongation of gastric emptying. This subset represents a higher risk group. This coupled with GORD would likely mandate endotracheal intubation.
- *Reducing gastric acidity.* Administration of a single dose of ranitidine 150 mg a few hours before induction significantly increases gastric pH and reduces gastric volume.^{27,28} Clinical trials have shown that lansoprazole, rabeprazole and omeprazole are most effective when given in two successive doses, the evening before and on the morning of anaesthesia.^{27,28} (PPIs should be given as two doses.) If a single dose is to be used, then rabeprazole and lansoprazole should be given on the morning of anaesthesia, while omeprazole should be given the previous night.⁶ It must be noted that ranitidine is as effective as two doses of any of

the PPIs in the preoperative setting in healthy patients. (It is important to note that clinical trials have been conducted in healthy patients and not those likely to regurgitate and aspirate.)

Intraoperative Considerations

Should an extraglottic device have been chosen for a patient with possible or confirmed GORD after taking the above points into consideration, the following points should be considered:

- *Reduction of gastric volume.* Orogastric tubes may be inserted during anaesthesia with certain extraglottic devices that have been designed with gastric access ports (e.g. ProSeal LMA™, LMA Supreme™). These devices have a superior seal pressure and gastric drain tube, but the user needs to ensure that this is placed properly as malposition can lead to problems. Passage of a nasogastric tube and aspiration in patients with suspected or documented GORD to empty the stomach is acceptable and advisable. Successful passage of an orogastric tube through these devices also suggests correct positioning of the airway device making complications due to malposition less likely. It is important to note that these tubes decrease LOS tone thereby reducing barrier pressure and making reflux likely. Passage of the tube with aspiration and then subsequent removal is likely to decrease the risk of aspiration due to this decreased barrier pressure.

Orogastric tubes with a gastric balloon are marketed, whereby the balloon is insufflated to occlude the gastric cardia.²⁹ These tubes may reduce the risk of aspiration when an LMA is used in a patient who is likely to have oesophageal reflux.⁶

- *Constant visualisation of the airway device.* The airway device chosen should be kept in plain view of the attending anaesthesiologist. Should any fluid/gastric content reflux, it is likely to exit via the gastric access port. Should fluid/gastric content appear in the airway tract, the mask should be removed immediately, oropharynx well suctioned, and the patient intubated with an endotracheal tube.
- *Barrier Pressure Considerations.* The use of the LMA (most studied extraglottic device) is associated with a reduction in barrier pressure at the LOS.³⁰ This reduction is thought to be

caused by a mechanoreceptor reflex caused by pharyngeal pressure. Provided the patient is kept supine and not in the lithotomy position, there does not appear to be an increased risk of reflux.⁶

Avoidance, where possible, of drugs that decrease LOS tone (such as opioids where local anaesthesia can be used for postoperative pain) is advisable.

- *Spontaneous and positive pressure ventilation.* Some authors have suggested that the use of an extraglottic airway device during either spontaneous ventilation³¹ or positive pressure ventilation³² may promote gastro-oesophageal reflux. It has been suggested that during spontaneous ventilation, a high negative intrathoracic pressure may be generated during inspiration and that during positive pressure ventilation, gastric insufflation may occur and cause increased intragastric pressures.

In two later studies (one to compare 40 patients undergoing laparoscopic gynaecological procedures and the other a variety of surgical procedures), there was no significant difference in the incidence of regurgitation between the two groups.^{33,32}

Summary

Gastro-oesophageal reflux and aspiration in the general healthy population is a rare complication of anaesthesia. Gastro-oesophageal reflux disease (GORD) is a common disease with extremely variable severity. Airway management in this subset of patients with GORD is controversial. Increasing confidence of anaesthetists in the safety of extraglottic airways is leading to the expansion of their use into patients with a history of, or risk of gastro-oesophageal reflux without published trials supporting this practice. This practice is likely to be due to the possible risks and complications of endotracheal intubation.

Disadvantages of extraglottic airway devices over endotracheal tubes include lack of airway protection against aspiration, difficulty in ventilation with malposition, air leak or decreased chest/lung compliance, and the risk of gastric aspiration as a result of high inspiratory pressures.

The use of extraglottic airway devices in patients with GORD should be preceded by a good history and examination, directed premedication, and limited to those patients that are controlled on medication with mild disease, short duration surgery with the continuous possibility of visualisation and access to the patient's airway, surgery in the supine position, and only by experienced users with directional extraglottic airway devices with separate gastrointestinal and airway tracts. Absolute indications for endotracheal intubation must be absent. The overriding principle of choosing the appropriate airway management device must be that the patient should not be compromised by the choice of airway device, and that the ultimate decision is more likely to benefit the patient than cause harm. If there is any doubt or hesitation with respect to this or possible regurgitation – endotracheal intubation is indicated and the endotracheal tube MUST be the airway of choice.

References:

1. Shaheen NJ, Hansen RA, Morgan DR, et al. The burden of gastrointestinal and liver diseases, 2006. *Am J Gastroenterol* 2006;101:2128–38.
2. Dent J, Armstrong D, Delaney B, Moayyedi P, Talley NJ, Vakil N. Symptom evaluation in reflux disease: workshop background, processes, terminology, recommendations and discussion outputs. *Gut* 2004;53 (suppl 4):iv1–iv24.
3. Vakil N, van Zanten SV, Kahrilas P, Dent J, Jones R. The Montreal definition and classification of gastroesophageal reflux disease: a global evidence-based consensus. *Am J Gastroenterol* 2006;101:1900–20.
4. Dent J, Brun J, Fendrick M, Fennerty MB, Janssens J, Kahrilas PJ, et al. An evidence-based appraisal of reflux disease management: the Genval Workshop Report. *Gut* 1999; 44 (suppl 2):S1–S16.
5. Kahrilas PJ. Gastroesophageal reflux disease. *NEJM* 2008; 359(16):1700–1707.
6. Alexander NG, Smith G. Gastroesophageal reflux and aspiration of gastric contents in anaesthetic practice. *Anesth Analg*, 2001;93:494–513.
7. Kluger MT, Short TG. Aspiration during anaesthesia: a review of 133 cases from the Australian Anaesthetic Incident Monitoring Study (AIMS). *Anaesthesia* 1999;54:19–26.
8. Warner MA, Warner ME, Weber JG. Clinical significance of pulmonary aspiration during the perioperative period. *Anesthesiology* 1993;78:56–62.
9. Olsson GL, Hallen B, Hambraeus-Jonzon K. Aspiration during anaesthesia: a computer-aided study of 185 358 anaesthetics. *Acta Anaesthesiol Scand* 1986;30:84–92.
10. Cotton BR, Smith G. The lower oesophageal sphincter and anaesthesia. *Br J Anaesth* 1984;56:37–57.
11. Skinner HJ, Bedforth NM, Girling KJ, Mahajan RP. Effect of cricoid pressure on gastroesophageal reflux in awake patients. *Anaesthesia* 1999;54:798–808.
12. Gardaz JP, Theumann N, Guyot J, et al. Effects of propofol on lower oesophageal sphincter pressure and barrier pressure. *Eur J Anaesthesiol* 1996;13:203.
13. Orr WC, Heading R, Johnson LF, et al. Review article: sleep and its relationship to gastro-oesophageal reflux. *Aliment Pharmacol Ther* 2004;20(Suppl 9): 39–46.
14. Kahrilas PJ, Dodds WJ, Dent J, et al. Effect of sleep, spontaneous gastroesophageal reflux, and a meal on upper oesophageal sphincter pressure in normal human volunteers. *Gastroenterology* 1987;92:466–71.
15. Erskine RJ, Murphy PJ, Langton JA, Smith G. Effect of age on the sensitivity of upper airway reflexes. *Br J Anaesth* 1993;70:574–5.
16. Caranza R, Nandwani N, Tring JP, et al. Upper airway reflex sensitivity following general anaesthesia for day-case surgery. *Anaesthesia* 2000;55:367–70.
17. McIntyre JWR. Evolution of 20th century attitudes to prophylaxis of pulmonary aspiration during anaesthesia. *Can J Anaesth* 1998;45:1024–30.
18. Mellin-Olsen J, Fastin S, Gisvold SE. Routine preoperative gastric emptying is seldom indicated: a study of 85 594 anaesthetics with special focus on aspiration pneumonia. *Acta Anaesthesiol Scand* 1996;40:1184–8.
19. Warner MA, Warner ME, Warner DO, et al. Perioperative pulmonary aspiration in infants and children. *Anesthesiology* 1999;90:66–71.
20. Ezri T, Szmuk P, Stein A, et al. Peripartum general anaesthesia without tracheal intubation: incidence of aspiration pneumonia. *Anaesthesia* 2000;55:421–6.
21. Hohlrieder M, Brimacombe J, Eschertzhuber S, et al. A study of airway management using the ProSeal LMA1 laryngeal mask airway compared with the tracheal tube on postoperative analgesic requirements following gynaecological laparoscopic surgery. *Anaesthesia* 2007;62:913–918.
22. Blunt MC, Young PJ, Patil A, Haddock A. Gel lubrication of the tracheal tube cuff reduces pulmonary aspiration. *Anesthesiology* 2001;95:377–81.
23. Cook TM. Novel airway devices: spoilt for choice? *Anaesthesia* 2003; 58:107–110.
24. Crilly H, McLeod K. Use of the laryngeal mask airway—a survey of Australian anaesthetic practice. *Anaesth Intensive Care* 2000; 28:224. (Abstract).
25. Jolliffe L, Jackson I. Airway management in the outpatient setting: new devices and techniques. *Curr Opin Anaesthesiol* 2008; 21:719–722.
26. Miller DM. A proposed classification and scoring system for supraglottic sealing airways: a brief review. *Anesth Analg* 2004; 99:1553–1559.
27. Nishina K, Mikawa K, Takao Y, et al. A comparison of rabeprazole, lansoprazole and ranitidine for improving preoperative gastric fluid property in adults undergoing elective surgery. *Anesth Analg* 2000;90:717–21.
28. Nishina K, Mikawa K, Maekawa N, et al. A comparison of lansoprazole, omeprazole and ranitidine for reducing preoperative gastric secretion in adult patients undergoing elective surgery. *Anesth Analg* 1996;82:832–6.
29. Roewer N. Can pulmonary aspiration of gastric contents be prevented by balloon occlusion of the cardia? A study with a new nasogastric tube. *Anesth Analg* 1995;80:378–83.
30. Rabey PG, Murphy PJ, Langton JA, et al. Effect of the laryngeal mask airway on lower oesophageal sphincter pressure in patients during general anaesthesia. *Br J Anaesth* 1992;69:346–8.
31. Owens TM, Robertson P, Twomey C, et al. The incidence of gastroesophageal reflux with the laryngeal mask: a comparison with the face mask using esophageal lumen pH electrodes. *Anesth Analg* 1995;80:980–4.
32. Akhtar TM, Street MK. Risk of aspiration with the laryngeal masks. *Br J Anaesth* 1994;72:447–50.
33. Skinner HJ, Ho BYM, Mahajan RP. Gastroesophageal reflux with the laryngeal mask during day-case gynaecological laparoscopy. *Br J Anaesth* 1998;80:675–6.