Prevention of aspiration pneumonitis: Preoperative preparation

GLENN A. HARDESTY, CRNA, ANC
Colorado Springs, Colorado

The author reviews physical and definitive preparation of patients prior to elective and emergency surgery as a means of preventing aspiration pneumonitis. Special emphasis is accorded the H₂ antagonist cimetidine, and suggested premedication protocols are included.

Aspiration pneumonitis (Mendelson's syndrome) is still one of the most fatal complications resulting from anesthesia. The goal of this article is to review old and new methods to prevent this complication.

The critical volume and pH of the aspirate, contributing to a mortality as high as 70%, has been determined to be 25 cc (0.3-0.4 cc/kg) and a pH of 2.5. The symptoms from aspirating gastric contents in the above ranges include: tachypnea, dyspnea, cough, cyanosis, and pulmonary edema. These are usually followed by pulmonary infiltrate, atelectasis, and fever.

Regional anesthesia is advocated whenever possible to alleviate this complication. However, there are many instances when regional anesthesia is not applicable: acute fetal distress, clotting disorders, hypovolemia, anemia and other contraindications.

One must also remember that regional anesthesia is not devoid of risks; convulsions or a high spinal may necessitate resuscitation and intubation, therefore, the risk of vomiting and aspiration may still be present. Steps to prevent aspiration pneumonitis should be considered not only when anesthetizing the obstetrical or emergency patient, but also for the elective patient. Studies have shown that a high percentage of "prepared" elective surgical patients arrive for surgery with the pH of gastric fluid below 2.5.

Physical methods to reduce the risk of aspiration pneumonitis

The standard practice applied to the patient of NPO (nothing by mouth) after midnight the night preceding elective surgery comforts most anesthetists. However, Rennie and colleagues showed that more than 50% of their patients who had fasted for a minimum of six hours had a gastric pH of less than 2.5, and 40% of those patients had gastric volumes greater than 10 cc.

With the surgery table flexed, the patient is in the head-up position which allows gravity to aid in the prevention of silent regurgitation. This position is often accompanied by cricoid pressure (Sellick's maneuver). The cricoid pressure sufficient to reduce passive regurgitation is equal to the amount of pressure needed to illicit pain if applied to the bridge of the nose.

Passage of a nasogastric tube prior to induction of anesthesia will reduce part of the gastric volume. However, aspiration through a nasogastric tube does not guarantee an empty stomach.

Awake intubation with protective pharyngeal
reflexes intact is promoted.⁶ Also, blind intubation in cases of predicted reflux is suggested; if the esophagus is inadvertently intubated, allow the tube to remain in the esophagus to direct stomach contents away from the trachea while another tube is passed into the appropriate orifice.⁸ In addition to the aforementioned nasogastric tube, induced vomiting will decrease gastric contents.⁹

Definitive preparation of the patient

Anticholinergics. Atropine and glycopyrrolate are the two most predominant modern anticholinergics. Atropine is an effective vagolytic in appropriate dosages but it has been shown to have little or no effect on gastric volume and pH. Glycopyrrolate is more effective in reducing gastric volume and increasing gastric pH.⁸⁹ However, it consistently increases the pH over 2.5 in only 44-60% of patients studied, with a peak intramuscular (IM) effect in 30-45 min.¹⁰

Antacids have been advocated to increase gastric pH since 1946, when Mendelson reported on aspiration pneumonitis.¹¹ Antacids are effective in increasing the gastric pH at the time when they are administered; but the inconsistency in pH changes, inherent increased gastric volume and delayed gastric emptying time may result in pneumonitis from aspirated antacid.¹² In spite of the administration of antacids, 16% of the cases in a study by Detmer still had a gastric pH less than 2.5 and this percentage rapidly increased with time.¹³ Therefore, the anesthetist should allow minimal time to elapse between administration of an antacid and induction of anesthesia.

Cimetidine (Tagamet®) is a relatively new agent with a promising future in anesthesia premedication where the goal is to reduce the risk of aspiration pneumonitis. Cimetidine is an H₂ receptor antagonist.¹⁴ The parietal cells of the stomach secrete gastric acid in response to three agonists: acetylcholine, gastrin and histamine. The H₂ receptors are activated by histamine, probably enhancing the parietal cells’ affinity for gastrin or acetylcholine. Cimetidine antagonizes the H₂ receptor and blocks the response to gastrin and acetylcholine.¹⁵ Thus the volume of acid secreted is decreased and the gastric pH increases.

Cimetidine has been shown to increase the pH greater than 2.5 in 100% of the cases when given by mouth (PO) two hours prior to induction; 75% of the patients also have a gastric volume of less than 25 cc.¹⁶ In comparing glycopyrrolate with cimetidine, it was found that although both decreased gastric volume equally after one hour, cimetidine increased gastric pH greater than 2.5 in more than 90% of the cases; glycopyrrolate, on the other hand, was only effective in approximately 40% of the cases. (These figures are not significantly different from the control group.)¹⁷

A dosage of 5 mg/kg or 300 mg of cimetidine for the adult has been determined to be effective for increasing gastric pH greater than 2.5 and decreasing gastric volume less than 25 cc.¹⁸ There is no known hazard from single dose administration of cimetidine.¹¹ Long term administration of cimetidine has been associated with increased creatinine, sedation and the necessity for caution when used with anticoagulants.¹⁹

Pharmacokinetic studies comparing PO, IM and IV routes of cimetidine administration have shown that preoperative preparation via any route should be effective one to two hours prior to induction.

| Table 1 |
|---------------------|------------------|------------------|
| Route              | Peak             | Duration        |
| Intravenously*     | 7 min.           | 4-6 hours       |
| Intramuscularly    | 15-30 min.       | 4-6 hours       |
| Orally             | 60-90 min.       | 4-6 hours       |

*Cimetidine for IV use should be mixed in 20cc normal saline solution, and given slow IV push or IV piggyback.

Cimetidine is indicated as a premedication for patients with an increased risk of aspiration in situations including emergency surgery, hiatal hernia, increased intra-abdominal pressure, pregnancy, difficult intubation and when the patient receives anesthesia in a location other than the operating room. Considering the benign nature of the drug with one time administration, use of cimetidine in elective surgery should be encouraged.

On the horizon. At least two new drugs are now coming in use to reduce the risk of aspiration pneumonitis: metoclopramide, and domperidone. Although metoclopramide is not approved by the Food and Drug Administration (FDA) for use in the pregnant patient, its action of forward gastric emptying may be of use in the above cited indications for cimetidine.⁸

Domperidone, an antiemetic, has been studied in both pregnant and nonpregnant women and has been shown effective in increasing lower esophageal sphincter pressure, thereby decreasing the chance of gastric reflux and aspiration.²⁰
Preparing for elective and emergency surgery

The following are suggested protocols for preparing elective and emergency patients to decrease the incidence of aspiration pneumonitis.

**Elective surgery.** Administer 300 mg of cimetidine PO at bedtime the night before and at 0600 the day of surgery. The second dose may be ordered later in cases of anticipated late surgery; the second dose is ideally administered two hours prior to induction. Narcotics, sedatives and anticholinergics are ordered at the anesthetist’s discretion.

**Emergency surgery**: The following is a suggested protocol for preparing patients for emergency surgery and cesarean sections when regional anesthesia cannot be employed and the need for general anesthesia is highly probable: (1) cimetidine 300 mg IV push (5 mg/kg) STAT as soon as anesthesia is alerted for the case, (2) glycopyrrolate 0.005 mg/kg IM 30-45 min prior to induction, and (3) antacid 30 cc 10 min prior to rapid sequence induction-intubation with the patient’s head up and with cricoid pressure.

The rationale for this protocol is that IV cimetidine peaks in 7 min and increases the chance of having gastric pH greater than 2.5 and gastric volume less than 25 cc prior to induction; it will even more certainly increase pH and decrease volume prior to emergence from anesthesia. The glycopyrrolate will aid in decreasing the gastric volume and vagolysis, and is an excellent antispasmodic. Antacids will raise the pH of the gastric content still present at induction. Ultimately, the skill of the anesthetist in rapidly inducing and intubating the patient with minimal pharyngeal stimulus is also of great importance in reducing vomiting and aspiration.

**REFERENCES**


**AUTHOR**

Glenn A. Hardesty, CRNA, Cpt. US Army Nurse Corps, received his BA in Biology Cum Laude from Ohio Dominican College in Columbus, Ohio, and his BSN from Case Western Reserve University in Cleveland, Ohio. He is a graduate of the US Army Anesthesiology Course of Army Nurse Corps Officers at Fitzsimmons Army Medical Center. Captain Hardesty is presently a staff anesthetist at Fort Carson Army Hospital, Colorado Springs, Colorado.

The author wishes to state that the opinions in this article are his own and are not to be construed as those of the Department of Anesthesia, Fort Carson Army Hospital, the US Army Nurse Corps, the Department of Defense, or the Department of the Army.