Pleuropulmonary Complications of Enteral Tube Feedings*

Two Reports, Review of the Literature, and Recommendations

K. Scott Miller, M.D.; James R. Tomlinson, M.D.; and Steven A. Sahn, M.D., FCCP

Enteral tube feeding is an attractive alternative to intravenous alimentation for nutritional support. As previously used nasogastric tubes have been replaced with narrow-bore nasogastric tubes, the spectrum of complications seen with these devices has changed. We report a previously undescribed event associated with narrow-bore nasogastric tube feeding, review the literature, noting predisposing factors and complications, and suggest guidelines to avoid pitfalls of insertion and the ensuing adverse effects.

Enteral tube feeding of the chronically ill malnourished patient or those requiring short-term supplementation during an acute illness provides an attractive alternative to intravenous alimentation. The ease of insertion of the feeding tube and the paucity of complications in comparison with the myriad of adverse effects known to occur with central hyperalimentation are important advantages. Changing of intravenous catheters, recommended during periods of bacteremia or sepsis, is unnecessary with enteral feeding tubes. Administration of large volumes of fluid, hyperglycemia, and thrombosis of large vessels are potential problems associated with hyperalimentation and not commonly with enteral feeding.

Pleuropulmonary complications of enteral feeding tubes have been reported. We recently observed two patients who had narrow-bore nasogastric tubes passed beyond intact tracheostomy tubes and into the pleural space. It is the purpose of this report to describe this previously undocumented complication of enteral tube feeding and to discuss the pleuropulmonary complications that can occur and the predisposing factors that can lead to problems with enteral feeding.

CASE REPORTS

CASE 1

A 68-year-old woman with chronic obstructive pulmonary disease (COPD) was admitted to the Medical University Hospital for increasing shortness of breath. Pulmonary angiograms documented pulmonary thromboembolism, and therapy with heparin was initiated. The patient's medical history was complicated by chronic renal insufficiency, nephrotic syndrome of undefined etiology, a right mastectomy for breast cancer, and probable primary hyperparathyroidism. Worsening respiratory failure required ventilatory support and subsequent tracheostomy. Nutritional support was delivered via central hyperalimentation, with periodic trials of enteral tube feedings.

On the 40th day of hospitalization, the patient had reintroduction of a feeding tube (Entriflex) by nursing personnel. After "documentation" of placement in the stomach by auscultation, infusion of a feeding solution (Isocal) was initiated. On the following day a routine chest x-ray film revealed a large right-sided pleural effusion (Fig 1A). Attempted thoracocentesis was unsuccessful. Placement of a chest tube for removal of the effusion drained 2,000 ml of white milky fluid consistent (by chemical analysis) with the feeding solution (Isocal). After placement of the chest tube, a roentgenogram (Fig 1B) showed the feeding tube to be coiled in the right pleural space. The tube had passed around the tracheostomy tube, with the balloon adequately inflated, and had perforated the right main-stem bronchus, coiling in the right pleural space. Resolution of the pleural effusion with chest tube drainage and removal of the feeding tube occurred without evidence of bronchopleural fistula.

CASE 2

A 61-year-old man was admitted to the Medical University Hospital for acute epidural bleeding and C3-4 cervical displacement due to trauma. The patient had three craniotomies for recurrent epidural hemorrhage and an episode of aspiration pneumonia. A tracheostomy was performed on the ninth day of hospitalization for anticipated prolonged mechanical ventilation. On the 52nd day of hospitalization, placement of a feeding tube (Entriflex) was attempted to initiate enteral feeding. After placement of the tube, a chest roentgenogram revealed that the tube had passed the intact inflated tracheostomy tube balloon, perforated a bronchus, and curled in the right pleural space (Fig 2A). The feeding tube was withdrawn.

After a subsequent chest roentgenogram did not reveal a pneumothorax, a second attempt was made to place a feeding tube (Entriflex) into the stomach. On the follow-up chest roentgenogram, the tube was noted to have perforated a bronchus and curled into the left pleural space after again passing the intact, inflated tracheostomy tube balloon (Fig 2B). A right pneumothorax had developed as well. The feeding tube was removed. The patient subsequently developed bilateral pneumothoraces requiring insertion of bilateral chest tubes (Fig 2C). Uneventful recovery ensued, with resolution of the bilateral pneumothoraces.

DISCUSSION

When a foreign object is inserted into the body, it can cause injury from the site of entry to the site of distal placement. Since the introduction of nasogastric
tubes, refinements have been made, and the spectrum of injuries has changed. Earlier large-bore stiff tubes (16 to 20 French) were inserted easily, but there were problems related to the patient's comfort and to ischemia and necrosis of superficial tissues due to compression of the tube against mucosal surfaces. Ulceration and bleeding from the nose, posterior larynx, esophagus, and stomach were reported. Tracheoesophageal fistulas also were a known complication. These larger tubes also were capable of perforating the esophagus and entering the tracheobronchial tree. In order to eliminate these problems, narrow-bore nasogastric tubes were developed. They range from 12 French (4 to 5 mm in external diameter) to 1 to 2 mm in external diameter and are soft pliable polyvinylchloride-based tubes with weighted ends and stylets for use on insertion. These stylets give stiffness and strength to the tubing and allow easier advancement of the device; however, with insertion of the stylet, the tubing becomes stiff and could perforate a number of structures if excessive pressure is applied with the distal tip deflected against an organ.

The procedure for passage of a nasogastric tube has been described. Passage of a narrow-bore nasogastric tube is similar. In general, it involves having the sitting patient swallow repeatedly when the tube enters the

![Figure 1](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21480/)

**Figure 1.** Sixty-eight-year-old white woman with COPD and pulmonary thromboembolism with tracheostomy in place and receiving mechanical ventilation. A (left). New, large, right-sided pleural effusion documented on routine roentgenogram taken 24 hours after insertion of narrow-bore nasogastric feeding tube and infusion (isocaud). Note metallic densities from previous breast surgery. B (right). Roentgenogram after placement of chest tube, demonstrating narrow-bore nasogastric tube coiled in right pleural space (arrows).

![Figure 2](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21480/)

**Figure 2.** Sixty-one-year-old black man with recurrent epidural hemorrhage and prolonged mechanical ventilation via tracheostomy tube. A (left). Narrow-bore nasogastric tube noted to pass around tracheostomy tube and into right pleural space. B (center). Narrow-bore nasogastric tube coiled in left pleural space (small arrow) after passing inflated tracheostomy cuff (large arrow). Note development of pneumothorax and previously documented pleural effusion on right in this supine view. C (right). Roentgenogram obtained after removal of narrow-bore nasogastric tube in Figure 2B, displaying bilateral pneumothoraces.
There are a number of commonly accepted guidelines which suggest proper tube placement: (1) insufflation of air with sounds heard over the left upper quadrant (stomach); (2) aspiration of fluid, suggesting placement in the stomach; (3) passage of the tube the full distance (60 cm) with easy removal of the stylet, suggesting that the tubing is straight, not kinked, and unlikely to be in the bronchial tree; and (4) absence of coughing, suggesting esophageal passage of the tube.

Difficulties occur in the passage of tubes in patients who are uncooperative, obtunded, demented, critically ill, or receiving mechanical ventilation. Such patients are not able to cooperate and are at risk for complications of tube placement. Table 1 lists pleuropulmonary complications and sequelae of enteral feeding tubes previously reported in the literature. Review of these cases focuses attention on techniques of placement and should raise the index of suspicion for complications in patients with underlying risk factors. Major risk factors included depressed sensorium, impaired gag reflex, recent endotracheal intubation, decreased laryngeal sensitivity, esophageal strictures, enlarged heart, and neuromuscular blocking drugs. Complications arise from insertion of the tube into the lung or pleural space, with subsequent infection, bleeding, or introduction of air into a closed space. Pleuropulmonary complications include the following: pneumomediastinum; subcutaneous emphysema; pneumothorax; pneumonitis; pulmonary edema, pleural effusions; empyema; bronchopleural fistula; hemothorax; and perforation of the esophagus.** Traditional criteria for placement have been shown to be suboptimal.

In light of these potential hazards, only personnel familiar with placement of narrow-bore nasogastric tubes should pass these tubes. If any resistance is met with passage, the tube should be removed and repositioned. Removal and reinsertion of the stylet should be avoided, as with reinsertion the stylet can exit through a feeding port and puncture any structure. Of note, a recent modification of the distal end of the tube reportedly prevents the stylet from exiting through a feeding port; however, caution advises against this to absolutely avoid this possibility. Coughing or any evidence of respiratory distress should prompt removal of the tube. It has been shown that an endotracheal tube does not prohibit passage of a feeding tube into the lungs. Likewise, the violation of the pleural space in a patient with a tracheostomy, whose

<table>
<thead>
<tr>
<th>Reference</th>
<th>Description of Patient*</th>
<th>Type of Tube†</th>
<th>Roentgenogram after Placement</th>
<th>Complication‡</th>
<th>Predisposing Factor</th>
<th>Sequelaet</th>
</tr>
</thead>
<tbody>
<tr>
<td>James †</td>
<td>S/P MV replacement with tracheostomy</td>
<td>2-mm NBNG tube</td>
<td>Obtained; not reviewed</td>
<td>Perforation of esophagus into pleural space</td>
<td>Enlarged heart; deflected tube laterally</td>
<td>None; treated with antibiotics</td>
</tr>
<tr>
<td>Vaughan †</td>
<td>S/P radical neck with removal of tracheostomy</td>
<td>NBNG tube</td>
<td>Obtained; not reviewed</td>
<td>Perforation of right main-stem bronchus into pulmonary parenchyma</td>
<td>Heating tracheostomy stoma; decreased cough reflex</td>
<td>70 percent oxygen; steroids; antibiotics; fluids; suctioning</td>
</tr>
<tr>
<td>Harvey et al †</td>
<td>S/P right radical maxillectomy</td>
<td>NBNG tube</td>
<td>Not obtained</td>
<td>Passage of tube into RLL with infusion of enteral feeding</td>
<td>Frequent regurgitation of tube</td>
<td>Intubation; mechanical ventilation for 60 hrs</td>
</tr>
<tr>
<td>Muthuswamy et al †</td>
<td>COPD with respiratory failure on ventilator</td>
<td>16 French Salem</td>
<td>Not obtained</td>
<td>Infusion of feeding (Isocal) into RLL</td>
<td>Endotracheal tube</td>
<td>Death</td>
</tr>
<tr>
<td>Culpapper et al †</td>
<td>Depressed mental status secondary to brain tumor</td>
<td>NG tube not described</td>
<td>Not obtained</td>
<td>Hydro pneumothorax; bronchopleural fistula</td>
<td>Decreased mental status</td>
<td>Chest tube placement</td>
</tr>
<tr>
<td>Baloch et al †</td>
<td>Intubated patient S/P CABG and MV replacement</td>
<td>NBNG tube</td>
<td>Obtained and reviewed</td>
<td>Perforation of R right main-stem bronchus into pleural space with 40 percent pneumothorax</td>
<td>Endotracheal tube</td>
<td>Chest tube placement</td>
</tr>
<tr>
<td>McDanal et al †</td>
<td>Patient 90 min after extubation</td>
<td>Not described</td>
<td>Not obtained</td>
<td>Pulmonary hemorrhage and effusion secondary to rupture of left main-stem bronchus</td>
<td>After extubation</td>
<td>Intubation, mechanical ventilation; antibiotics</td>
</tr>
</tbody>
</table>

* S/P, status/post; MV, mitral valve; and CABG, coronary artery bypass graft
† NBNG, Narrow-bore nasogastric; and NG, nasogastric.
‡ RLL, Right lower lobe.

...
larynx and vocal cords are not disturbed by an endotracheal tube, as shown in these cases, should not give one a false sense of security when passing these devices in such patients. Once the tube is placed, traditional criteria for appropriate position should not be accepted; and prior to initiation of feeding, placement of the tube should be checked radiographically. Insufflation of air with sounds heard over the left upper quadrant should not be accepted as evidence of gastric placement because (1) small-bore tubes do not always allow sufficient passage of air; (2) vigorous peristalsis may be mistaken for insufflated air; (3) air bubbling in the pleura, lung, pharynx, or esophagus may be transmitted below the diaphragm; and (4) an inexperienced operator may misinterpret what is heard. Aspiration of fluid should not be interpreted as appropriate placement in the stomach because fluid aspirated may come from the pleural space, bronchial secretions, stomach, or even brain. It is said that if the tube passes the full 60 cm and the stylet is removed easily, the tubing is straight and unlikely to be kinked or coiled up in the lung; however, several reports refute this claim.

If it is difficult to pass a narrow-bore nasogastric tube, several options can be employed: (1) the narrow-bore nasogastric tube can be coupled with a large-bore nasogastric tube with a gelatin capsule passed into the stomach, with the larger tube removed when the capsule dissolves; (2) fluoroscopy may be employed, as the tube is radiopaque; (3) direct passage with the use of an endoscope; and (4) direct visualization of the larynx with a laryngoscope in a topically anesthetized patient with a posterior passage of the tube.

In summary, narrow-bore nasogastric tubes offer an attractive, safe way to supply the caloric needs of the acute or chronically ill patient but are not without risks. The operator's familiarity, nonforceful insertion, careful observation for respiratory distress, and dependence on a chest roentgenogram after placement reduces the complications of this procedure. A high index of suspicion for complications in a compromised patient will prevent accidental infusion of tube feeding into the lungs or pleural space. Finally, the presence of a cuffed tracheostomy tube does not prohibit advancement of an enteral feeding tube into the lungs.

REFERENCES
5 Harvey PB, Bull PT, Harris DL. Accidental intrapulmonary clinifeed. Anesthesiology 1981; 56:518-22
12 Fremsted JD, Martin SH. Lethal complication from insertion of nasogastric tube after severe basilar skull fracture. J Trauma 1978; 18:830-22