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Bilevel Nasal Positive Airway Pressure and Ballooning of the Stomach*

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We describe a case of severe gastric insufflation in a patient with amyotrophic lateral sclerosis who was receiving bilevel nasal positive airway pressure (BNPAP) ventilation (BiPAP; Respironics; Murrysville, PA). The injection of inspiratory flow into the esophagus, aerophagia, and air trapping below the gastroesophageal junction after a meal are probably the major causes. We suggest that BNPAP ventilation can be a cause of serious gastric insufflation in a patient who lies supine, especially after a meal, and attention should be paid to avoiding this complication by having the patient sit up for about half an hour after a meal.

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Key words: aerophagia; amyotrophic lateral sclerosis; bilevel nasal positive airway pressure; gastric insufflation; ileus; supine position

Abbreviations: ALS = amyotrophic lateral sclerosis; BNPAP = bilevel nasal positive airway pressure

Bilevel nasal positive airway pressure (BNPAP) [BiPAP system; Respironics Inc; Murrysville, PA] is now widely used for the management of respiratory insufficiency of various causes including amyotrophic lateral sclerosis (ALS), and its complications are well-known. Gastric insufflation is observed in 30 to 50% of patients receiving noninvasive positive-pressure ventilation, but it is usually not serious.¹ As

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far as we know, no one has reported on the potential danger of gastric insufflation in patients receiving BNPAP in the supine position, especially after a meal. We report on an unusual case in which severe gastric insufflation resulted from the injection of air into the esophagus by BNPAP and aerophagia.

CASE REPORT

A 42-year-old woman with ALS complained of gastric distension after a lunch of soup and noodles. She had been receiving BNPAP treatment for a year because of a rapid decline in respiratory function. She was using a standard nasal mask. The system had been set in the "spontaneous/timed" mode, and the inspiratory and expiratory pressures had been set at 14 and 4 cm H₂O, respectively. Her cranial nerves were normal except for a slight weakness and atrophy of the tongue. She could speak, eat, and drink but could not sit up because of generalized muscle weakness, joint contracture, and pain. She repeatedly vomited, eructated, and swallowed air. Her upper abdomen was tympanic, but bowel sounds were normal. Aerophagia was diagnosed, and the patient was treated with sedatives, which soon appeared to be ineffective. Treatment with decompression by means of a nasogastric tube was rejected by the patient.

Despite continued attempts by the staff, the patient became increasingly irritable and continued to vomit and swallow air. She appeared to be difficult to synchronize with the BNPAP ventilation system. In the late afternoon, her abdomen became fairly tense and tympanic. She complained of sharp abdominal pain and respiratory distress. Her arterial oxygen saturation level also declined. A radiograph revealed a large amount of air in the stomach and an elevated diaphragm (Fig 1). A forcibly inserted nasogastric tube immediately relieved her symptoms. Her bowels

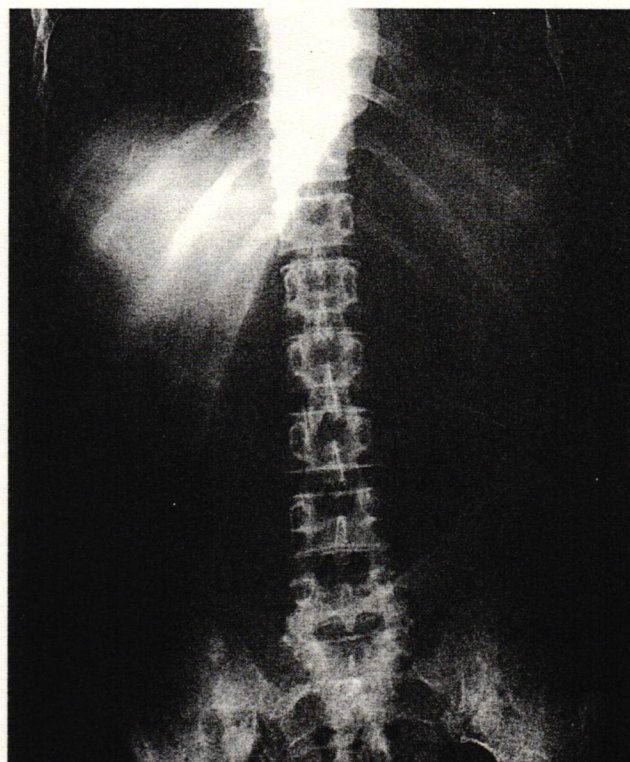


FIGURE 1. An abdominal radiograph showing a large amount of air in the stomach.

became paralytic, and her symptoms returned in the evening. Complete drainage of the gastric contents also gave a good result. The patient completely recovered by the next afternoon.

Because the patient's immediate recovery after decompression seemed rather atypical of aerophagia, we suspected that gastric air was injected by BNPAP ventilation. In reply to our question, she stated that the BNPAP ventilation system customarily injected air into her stomach when she opened her mouth. Usually, the air is soon expelled as belches and flatus, but on that day gastric distension appeared after lunch. Usually gastric distension after a meal would soon disappear, but it increasingly worsened on that day. Because of distress, she opened her mouth more frequently, and as a result a larger amount of air was injected into the stomach.

After this episode of aerophagia, we made the patient sit up for about half an hour after meals to allow the gastric air to be expelled. By this simple maneuver, severe gastric insufflation was successfully avoided thereafter.

DISCUSSION

On the basis of the patient's comment, we determined that her gastric distension probably was a result of air injection by BNPAP ventilation. This opinion is supported by a report stating that aerophagia is observed in 13% of patients receiving BNPAP ventilation.² Gastric insufflation is reported in up to 50% of patients receiving noninvasive positive-pressure ventilation but is rarely intolerable, probably because the lower esophageal sphincter pressure is well above the inspiratory positive airway pressure, which prevents the air from entering the gastric lumen.¹ Sphincter pressure in this patient was possibly decreased by the weakness of the diaphragm caused by ALS, and a relatively large amount of air was injected into the gastric lumen compared to patients with normal diaphragms. In addition, the mode of the BNPAP ventilation system might have contributed to the problem. The presence of gastric insufflation shows that the length of the inspiratory phase depended on the compliance both of the chest and the abdomen. Therefore, gastric insufflation might be worsened when the compliance of the abdomen is greater than that of the chest. This condition could have occurred if the BNPAP ventilation system had injected air while the patient's own respiratory cycle had been in the expiratory phase in which the compliance of the chest had increased while that of the abdomen had been relatively free from the respiratory cycle. This desynchronization could have occurred in this patient because the BNPAP ventilation system was in the spontaneous/timed mode. We think that these two factors (*ie*, ALS and spontaneous/timed mode) were the major causes of the gastric insufflation in this patient. The gastric insufflation, which usually had been tolerated by this patient, had seriously worsened on that day. What had caused this exacerbation?

We estimate that our patient's difficulty in the sitting position and the quality of the meal were the major causes. When a patient lies supine after a large meal, air in the stomach can be trapped below the gastroesophageal junction by overlying fluid.³ Although the amount of the meal (soup and noodles) was not large in this case, the soup in the gastroesophageal junction may have contributed to trapping the air in the stomach because the patient was supine. This possibility is supported by the fact that, in this

case, severe gastric insufflation had been successfully avoided by sitting up for half an hour after the meal. This case is, therefore, consistent with the report⁴ that lateral position is useful in relieving the gastric distension associated with nasal-mask ventilation. Mouth opening may be also important. In patients who are using a nasal mask, mouth opening leaks the inspiratory air, disturbs the rise in inspiratory positive airway pressure, and lengthens inspiratory time. Irregular mouth opening by our patient, which makes the inspiratory time also irregular, might have caused the patient's difficulty in synchronizing with the BNPAP ventilation system and might have made the gastric insufflation more severe. At the same time, the inspiratory flow also could have distended the upper esophagus and caused a subjective feeling of an object in the upper esophagus, and repeated attempts to swallow the "object" resulted in aerophagia with rapid gastric insufflation.

Gastric insufflation, which worsens the patient's quality of life, can be fatal in severe cases.⁵ Therefore, to avoid this complication in patients receiving BNPAP ventilation in the supine position, about half an hour of sitting up after a meal is desirable.

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Utility of Wang Needle Aspiration in the Diagnosis of Actinomycosis*

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