Use of an Endoscopy Face Mask in Patients With Gastric Distention Undergoing Noninvasive Ventilation for Acute Respiratory Failure: A Comparative Case Study Report

Ángel Ortega-González MD, José Carlos Serrano-Rebollo MD, José Javier García-López MD, Teresa Vargas-Hidalgo MD, and José Celdrán-Gil MD

We describe the use of an endoscopy face mask with a perforated membrane, which allows a nasogastric tube for continuous noninvasive ventilation in acute hypercapnic respiratory failure, in 2 patients who developed gastric distention. This interface was able to avoid most nonintentional leaks through the mask, as compared with a conventional approach, improving ventilation efficiency. To our knowledge, this is the first case report of an endoscopy face mask used in noninvasive ventilation for this specific side effect. *Key words: noninvasive ventilation; acute respiratory failure; gastric distention; leaks; face mask; nasogastric tube; asynchrony; side effect.* [Respir Care 2012;57(5): 794–797. © 2012 Daedalus Enterprises]

Introduction

Noninvasive ventilation (NIV) has become a standard treatment in acute and acute on chronic hypercapnic respiratory failure, especially in COPD exacerbations,[1] obesity-hypoventilation syndrome,[2] and other conditions such as chest wall deformities and neuromuscular diseases.[3] NIV treatment also reduces the need for orotracheal intubation and therefore morbidity and mortality linked to conventional ventilation.[4] Most common complications in patients undergoing continuous NIV are mask leakage and intolerance, nasal congestion or dryness, nasal bridge ulceration, facial pain, and eye irritation.[5] Although minor complications, they may require withdrawal of the treatment.[6] Gastric distention is less frequent among common side effects, but may lead to patient-ventilator asynchrony, pressure loss, delayed cycling, and ineffective efforts to trigger the ventilator. This is mainly due to nonintentional air leaks through the mask,[7] when a nasogastric tube must be placed, with a potential risk of failure and need of intubation.[8]

We describe the use of an endoscopy face mask (VBM, Sulz am Neckar, Germany), which includes a flexible silicone membrane with a 5 mm hole that permits the introduction of a nasogastric tube (16 French) through the lumen. We used the interface in 2 patients with acute respiratory failure, undergoing NIV in a bi-level pressure support mode with a double circuit (Airox-Covidien Supportair, Elancourt, France) and who developed gastric distention.

Ventilation and continuous monitoring were conducted in a respiratory monitoring unit (RMU) under the supervision of a pulmonologist. During the conventional approach (ComfortFull 2 SE, Respironics, Murrysville, Pennsylvania) (Fig. 1) and with the use of the endoscopy mask (Fig. 2), for each patient, we registered and compared for 5 min, with software (Airox Communication v3.5.1, Airox, Pau, France), the following ventilation parameters: flow and pressure curves, mean inspiratory positive airway pressure (IPAP) and expiratory positive airway pressure (EPAP), and mean respiratory rate (breaths/min). The mean leakage fraction, in percentage, was estimated from the difference between the mean inspired and expired tidal volume (V_T). We also measured stay at the RMU. In both

The authors are affiliated with the Respiratory Monitoring Unit, Pulmonology Department, Hospital General Nuestra Señora del Prado, Talavera de la Reina, Spain.

The authors have disclosed no conflicts of interest.

Correspondence: Ángel Ortega-González MD, Respiratory Monitoring Unit, Pulmonology Department, Hospital General Nuestra Señora del Prado, Carretera de Madrid, 45600 Talavera de la Reina, Spain. E-mail: aortegag@sescam.jccm.es.

DOI: 10.4187/respcare.01384

Fig. 1. Conventional facial mask with nasogastric tube underneath.

Fig. 2. Endoscopy mask with nasogastric tube through perforated membrane.

cases, administered F_{IO_2}, IPAP, and EPAP remained invariable with both masks. The endoscopy mask was then used afterwards until full recovery of the abdominal complication was achieved and removal of the nasogastric tube was possible. Consent was obtained from the patients, and the protocol was approved by the local research ethics committee.

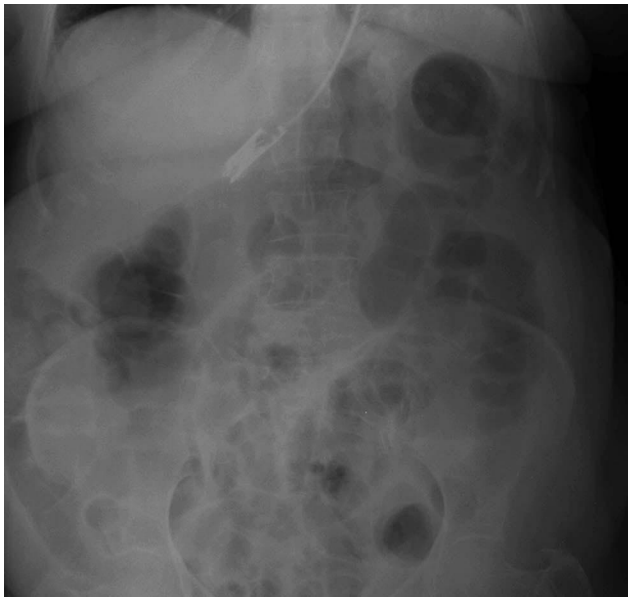

Fig. 3. Supine abdominal radiograph shows initial dilated gas-filled loops of small bowel and stomach.

Case Report 1

An 80-year-old female was hospitalized at the RMU, starting NIV for initial moderate hypoxemic-hypercapnic acidosis (initial arterial blood gases pH 7.28, P_{aO_2} 42 mm Hg, P_{aCO_2} 48 mm Hg, HCO_3^- 23 mmol/L, base excess −4.1 mmol/L, P_{aO_2}/F_{IO_2} 200 mm Hg) due to acute heart failure with atrial fibrillation and rapid ventricular response and severe asthma with a previous history of fixed air-flow obstruction. Initial physical examination showed severe generalized crackles and wheezes on thoracic auscultation, and a marked inspiratory and expiratory effort. On day 2 at the RMU the patient started complaining of diffuse abdominal pain and after a physical examination and abdominal radiography, gastric distention was suspected, with a need for continuous NIV due to respiratory worsening (pH 7.48, P_{aO_2} 65 mm Hg, P_{aCO_2} 55 mm Hg, HCO_3^- 41 mmol/L, base excess 17.5 mmol/L, P_{aO_2}/F_{IO_2} 185 mm Hg). Programmed IPAP and EPAP at that moment were 18 and 6 cm H_2O, respectively. A nasogastric tube was placed for 96 hours, and the patient made a full recovery from this condition (Fig. 3 shows supine abdominal radiography when gastric distention was suspected). During prolonged NIV with the endoscopy mask, no concerns regarding poor tolerance were reported.

Table 1. Ventilation Parameters During Conventional Approach and With the Endoscopy Mask

	Tidal Volume, mean mL		Leakage, %	Respiratory Rate, mean breaths/min
	Inspired	Expired		
Case 1				
Conventional	464.3	357.7	22.96	27.5
Endoscopy	424.6	424.5	0.02	22.3
Case 2				
Conventional	512.3	195.4	61.9	8.9
Endoscopy	478.8	477.3	0.31	7.7

The patient was discharged at day 14 with a complete withdrawal of NIV. During experimental tests, estimated leakage decreased from 22.96% with the conventional facial mask to 0.02% with the endoscopy mask. The respiratory rate also decreased. Comparative data during the conventional approach and with the endoscopy mask showing mean inspired V_T (mL), mean expired V_T (mL), leakage percentage, and respiratory rate are shown in Table 1. Total stay at the RMU was 8 days.

Case Report 2

A 76-year-old female was hospitalized at the RMU, starting NIV for initial mild hypoxemic-hypercapnic acidosis (initial arterial blood gases pH 7.31, P_{aO_2} 67 mm Hg, P_{aCO_2} 69 mm Hg, HCO_3^- 34.7 mmol/L, base excess 8.4 mmol/L, P_{aO_2}/F_{IO_2} 216 mm Hg), due to acute heart failure with atrial fibrillation and rapid ventricular response, renal insufficiency, and use of various sedative drugs, including lormetazepam, mirtazapine, and quetiapine for a bipolar disorder. The patient also had a history of obesity and previously well controlled hypothyroidism. Physical examination showed decreased chest sounds and generalized crackles on thoracic auscultation, and use of accessory muscles. At day 9 at the RMU she developed dysphagia and progressive abdominal dilatation and pain, with high suspicion of gastric distention, which was confirmed through abdominal radiography. In this clinical context the patient was in need of continuous NIV and had progressive growth of IPAP to 19 cm H_2O, with an EPAP of 6 cm H_2O at that moment, due to increased work of breathing with clinical exhaustion, and, finally, needed nasogastric tube placement during 18 days. During prolonged NIV with the endoscopy mask, patient tolerance was good. The patient died at day 38 due to septic shock of unknown origin and severe coagulopathy. During experimental tests, estimated leakage decreased from 61.85% to 0.31%, together with a decrease in respiratory rate. Comparative data during the conventional approach and with the endoscopy mask showing mean inspired V_T (mL), mean expired V_T (mL), leakage percentage, and respiratory rate are also shown in Table 1. Total stay at the RMU was 29 days.

Discussion

A face mask should be considered the first-line strategy in the initial management of hypercapnic acute respiratory failure with NIV. In this context, face masks improve minute ventilation and blood gases, when compared with different interfaces.[9] When NIV has to be prolonged, switching to a nasal mask may improve comfort by reducing face mask complications, including aerophagia. However, this is not always possible when the patient maintains a severe ventilatory failure or is incapable of correcting pH. Gastric distention could appear as a consequence of aerophagia during prolonged ventilation[10] and, when uncorrected, leads to fatal complications, including stomach rupture[11] and abdominal compartment syndrome.[6] The need of using a high IPAP, as happened in our patients, together with the need of continuous NIV, and its use supine and immediately after meals, increases the risk of this complication. The esophageal sphincter resists pressures up to 20 cm H_2O; thus, higher pressures could divert part of the V_T to the digestive tract.[12] Moreover, and with regard to this situation, using simple measures like decreasing IPAP and changing position to left lateral decubitus would be considered only provisional. When gastric distention appears, the introduction of a nasogastric tube is needed to prevent further complications, and both respiratory pattern and ventilation mechanics are changed, which could also increase the risk of failure. When abdominal distention is unresolved, it may develop to the point of increased abdominal pressure, leading to extrinsic compression of the pulmonary parenchyma and generating a restrictive respiratory pattern that would be potentially deleterious to the ventilation control, with a higher work of breathing and lower functional residual capacity, compromising mechanical ventilation efficiency, and could also have hemodynamic consequences.

This endoscopy mask was capable of diminishing almost completely the occurrence of air leaks around the interface. This allowed us to administer continuous ventilation safely and at the same time maintain a nasogastric tube, which, together with prokinetics, lead to the correction of gastric distention. Leaks play a major role in generating patient-ventilator asynchrony, and different studies have estimated their magnitude in a range between 25% and 39%.[13,14] As with other complications, this morbidity led to a prolonged stay at the RMU, in comparison with our previous data. After a search in the PubMed database for the terms "noninvasive ventilation" and "gastric distention," we did not find an alternative method to safely ventilate a patient under this condition with a facial mask

in adults. This strategy could be even more important when we treat a patient in hypercapnic failure, and therefore the use of an alternative interface with a port, like the helmet interface, could seem inappropriate from concerns about increased dead space.[15] Similarly, the use of a swivel adapter in the face mask for continuous NIV with a nasogastric tube may increase depressurization and leakage in relation to rigidity of the T-adapter, and does not include a separate port for the respiratory circuit.[16] The use of a separate sealing device with the mask may also preclude a prolonged use, due to skin irritation, the need of several readjustments, and leakage around the interface. We could therefore highlight that facial masks with a flexible perforated lumen could increase ventilation efficiency and reduce the risk of NIV failure.

In conclusion, the use of this endoscopy mask was a novel approach to gastric distention during continuous NIV, permitting the correction of most of the nonintentional leaks and therefore avoiding patient-ventilator asynchrony. We could speculate that the use of this special interface could lead to better clinical outcomes. To confirm this hypothesis more patients should be studied.

ACKNOWLEDGMENTS

We thank the nursing team at the Respiratory Monitoring Unit for their support with this study.

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