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Continuous Oxygen Insufflation Using a Speaking Tracheostomy Tube Is Effective in Preventing Aspiration During Feeding

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Aspiration during feeding in patients with tracheostomies and whose lungs are mechanically ventilated is a frequent and serious problem that can result in airway obstruction and pulmonary infection. We describe a patient with a cervical cord transection suffering from frequent aspiration during feeding. Fiberoptic examination revealed a disruption of the glottic closure reflex. Continuous insufflation of oxygen into the subglottic airway using a speaking tracheostomy tube restored competent glottic closure reflex and was effective in preventing aspiration.

Case Report

A 65-year-old man received a spinal cord injury due to fracture dislocation of the 4th and 5th cervical vertebra. Initial neurologic examination revealed bilateral anesthesia below the C4 levels and quadriplegia. Twenty-four hours after injury, tracheostomy was performed. Three days after injury, respiratory failure due to pulmonary congestion developed, and ventilation was mechanically supported. Twelve days after injury, posterior fusion of the 4th and 5th vertebra and iliac bone graft were performed to stabilize the cervical spine. The postoperative course was uneventful and the neurologic deficit was unchanged.

Thirty-seven days after injury, rehabilitation using oral feeding was begun. Deglutition was practiced carefully for 2 weeks using liquid and semisolid feeding mixtures. Swallowing appeared well coordinated. Although no signs of aspiration were observed during eating, tracheal suction revealed significant and frequent aspiration associated with feeding. Increasing pressure within the cuff of the tracheostomy tube during feeding did not prevent aspiration.

The glottic closure reflex was examined in detail using fiberoptic laryngoscopy. A 6.0 mm-ID armored endotracheal tube was inserted through the tracheostomy stoma to ventilate the lungs. The cuff was inflated using the minimal leak method to seal the trachea, and ventilation was supported manually using a Jackson-Rees system. A 5.0 mm-ID fiberoptic laryngoscope was inserted upward through the stoma to visualize glottic movement. A disruption of the glottic closure reflex during deglutition was observed. As shown in Figure 1, downward ballooning and incomplete closure of the true vocal cord was observed during the pharyngeal phase of deglutition. Premature opening of the glottis was followed by massive penetration of water into the trachea (Fig. 2). The cuff of the endotracheal tube was deflated by 50% to allow air flow into the larynx, and the glottic closure reflex was reassembled. When continuous positive subglottic airway pressure was applied manually during deglutition, downward ballooning of the tracheal tube disappeared, and the glottis remained closed. No significant penetration of water was observed.

To apply continuous positive subglottic airway pressure during feeding, a speaking tracheostomy tube (Argyle Aspirad, Nihon Shwood, Tokyo, Japan) was inserted. Through the narrow-gauge pilot tube ending above the cuff, humidified oxygen was insufflated into the subglottic airway continuously during feeding. Oxygen insufflation at the rate of 1 L/min, optimal for phonation in this patient, abolished aspiration. Suction through the same tube demonstrated absence of food particles or liquid residue in the subglottic airway. Five days after the initial fiberoptic examination, a second fiberoptic examination was performed to assess any unexpected effects of oxygen insufflation. No significant abnormality was observed in subglottic and tracheal mucosa. Seventy-one days after injury, separation from mechanical ventilation was accomplished successfully.

Discussion

It is well known that tracheostomy causes swallowing dysfunction and may promote pulmonary aspiration. Cameron et al. reported that the presence of an inflated tracheal cuff does not reduce the incidence of aspiration. In the current case, increasing tracheal cuff pressure during and after feeding did not effectively prevent aspiration. A videofluoroscopic study demonstrated that impaired laryngeal closure during deglutition is responsible for penetration of food into the airway below the true vocal folds. In patients with impaired laryngeal closure, clearance of food particles and liquid residue from the larynx before inspiration is crucial to prevent aspiration. However, insertion of a cuffed soft

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tracheostomy tube abolishes expiratory air flow (coughing) through the larynx. Stasis of secretions and food between the true vocal folds and the tracheal cuff eventually will induce aspiration into the lower airway. Using a speaking tracheostomy tube similar to ours, Shahvari et al. demonstrated that removal of fluid from the subglottic airway was useful in preventing aspiration. However, continuous suction of the subglottic airway during deglutition may promote penetration of food through the glottic opening. Moreover, it is difficult to remove food particles completely through the narrow-gauge pilot tube. Therefore, restoration and enforcement of laryngeal closure during deglutition is of primary importance in preventing aspiration in these patients.

The glottic closure reflex plays a central role in laryngeal closure during deglutition. In the current case, incomplete closure and early opening of the glottis were observed, accompanied by massive penetration of water into the subglottic airway. Sasaki et al. demonstrated in a series of animal experiments that tracheostomy led to disruption of the glottic closure reflex. They suggested that neurophysiologic change after tracheostomy, as in the current case, may cause diminished after-discharge activity of the thyroarytenoid muscle and result in a weakened and unsustained adductor.

Fiberoptic examination clearly demonstrated that manually increased subglottic airway pressure was effective in enforcing the glottic closure reflex, restoring competent laryngeal closure in this patient. Continuous oxygen insufflation into the subglottic airway using a speaking tracheostomy tube was effective in preventing aspiration. It is suggested that increased subglottic airway pressure by continuous oxygen insufflation may be effective in enforcing laryngeal closure during deglutition and preventing penetration of food into the subglottic space. An insufflation flow rate of 1 l/min was selected by the patient for comfortable phonation. This flow rate proved effective in enforcing laryngeal closure.

Although the current case demonstrates that continuous oxygen insufflation into the subglottic airway is useful in preventing aspiration during feeding, nonphysiologic flow of poorly humidified gas for a long period might be harmful to the airway mucosa. In this patient, no acute change of the glottic and tracheal mucosa was observed by fiberoptic examination.
other study of this issue is necessary to assess the clinical validity of this simple method.

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Neostigmine, Atropine, and Glycopyrrolate: Does Neostigmine Cross the Placenta?

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DRUGS administered to the mother can cross the placenta and affect the fetus. Following is a description of such an event.

Case Report

The patient was a 22-yr-old pregnant woman (gravida 1, para 0). The gestational age of the fetus was estimated to be 31 weeks. The patient was diagnosed as suffering from paranoid schizophrenia and was receiving haloperidol and lorazepam. She required open resection of a fractured elbow. General endotracheal anesthesia was used (the patient would not cooperate for regional anesthesia); the primary anesthetics were isoflurane and nitrous oxide. Thiopental was used for induction of anesthesia, succinylcholine to facilitate intubation, and vecuronium to prevent patient movement during the operation. The fetal heart rate and uterine contractions were monitored externally during the procedure. Left uterine displacement was performed. The patient was not in labor. Surgery proceeded satisfactorily, and the muscle relaxant effect was reversed at the termination of the anesthetic with neostigmine (5 mg) and glycopyrrolate (1 mg) intravenously. Preoperatively, the fetal heart rate was 153 beats/min but varied between 115 and 150 beats/min intraoperatively. Fetal heart rate immediately decreased to the range of 90-110 beats/min after administration of neostigmine and glycopyrrolate. Left uterine displacement was increased, and the fetal heart rate gradually returned to 120 beats/min. No atropine was given. The rate eventually reached 130 beats/min after 1 h. Four days postoperatively, however, the surgical repair was deemed unsatisfactory, and the patient underwent surgery. As before, general anesthesia was used along with vecuronium. Fetal heart rate and uterine contractions were monitored, and left uterine displacement was performed. At the end of the anesthetic, the muscle relaxant was antagonized with neostigmine (5 mg) and atropine (0.4 mg) intravenously. There was no change in fetal heart rate. The patient awoke satisfactorily from the anesthetic without complication and delivered a healthy infant at term.

Discussion

It is well known that atropine will cross the placenta and that maternal administration results in an increase in the fetus heart rate. The amniontum anticholinergic has been incompletely studied, but it found that a maximal transfer ratio at equilibration is indicated partial transfer at equilibrium.

Most of the studies on anticholinesterases differing in the authors have been five case reports of labor and the subsequent use of neostigmine (1). One of the studies, and another recent presented two case reports of the diagnosis, course of patients with myasthenia gravis. In these cases, the neostigmine or presented three case reports: two of the patient's eight patients underwent surgery in their clinical condition, but the level was not described (6). None of the reports included the identification of the infant. Eden and Galloway (7) described the neonatal myasthenia in infants. With regard to the infant, the onset of the infant may be delayed by the acquisition of the illness by the patient or to the mother. Atropine is a lipophilic drug and is expected to cross the base of the placenta. It dissociates from the biologic membranes of the placenta and is then ionized. The lipid-soluble fraction is the coefficient of 1. The biologic membranes and glycopyrrolate are not ionized and would be expected to transfer. Both exhibit a positive charge in the muscle cells, and the placenta is a lipid filter.

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