

6. Gaffney FA, Bastran BC, Lane LB, Taylor WF, Horton J, Schutte JE, Graham RM, Pettinger W, Bloomquist CG: Abnormal cardiovascular regulation in the mitral valve prolapse syndrome. *Am J Cardiol* 52:316-320, 1983
7. Boudoulas H, Reynolds JC, Mazzaferri E, Wooley CF: Mitral valve prolapse syndrome: The effect of adrenergic stimulation. *J Am Coll Cardiol* 2:638-644, 1983
8. Chan BL, Chen WWC, Wong PHC, Chow JSF: Skeletal abnormalities in mitral-valve prolapse. *Clin Radiol* 34:207-213, 1983
9. Abbasi AS, DeCristofaro D, Anabtawi J, Irwin L: Mitral valve prolapse: Comparative value of M-mode, 2 dimensional and Doppler echocardiography. *J Am Coll Cardiol* 2:1219-1223, 1983
10. Popp RL, Winkle RA: Mitral valve prolapse syndrome. *JAMA* 236:867-870, 1976
11. Abinader ED: Adrenergic beta-blockade and ECG changes in systolic click murmur syndrome. *Am Heart J* 91:297-302, 1976
12. Pocock W, Barlow J: Post-exercise dysrhythmias in the billowing posterior mitral leaflet syndrome. *Am Heart J* 80:740-745, 1970
13. Kaplan EL, Anthony BF, Bisno A, Durack D, Houser H, Millard HD, Sanford J, Shulman ST, Stillerman M, Taranta A, Wenger N: Prevention of bacterial endocarditis. *Circulation* 56:139A-143A, 1977
14. Corrigan D, Bolen J, Hancock EW, Popp RI: Mitral valve prolapse and infective endocarditis. *Am J Med* 63:215-222, 1973
15. Pandian MG, Lichtman A: Mitral valve prolapse and bacterial endocarditis. *Conn Med J* 40:675-676, 1976
16. Shappell SD, Marshall CE: Ballooning posterior leaflet syndrome. Syncope and sudden death. *Arch Intern Med* 135:664-667, 1975

Anesthesiology
62:664-666, 1985

Percutaneous Transtracheal Ventilation for Emergency Dental Appliance Removal

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High-frequency ventilation has been used via endotracheal and transtracheal routes for ventilation during surgery and emergency airway support.^{1,2} Occasionally transtracheal ventilation has been used in cardiopulmonary resuscitation.³ In this report a patient is described with partial upper airway obstruction from a hypopharyngeal foreign body with four sharp appendages. Notably percutaneous transtracheal ventilation was utilized successfully to provide an airway during removal of a foreign body, thus avoiding tracheostomy.

REPORT OF A CASE

The patient was a permanently institutionalized 65-year-old man with chronic schizophrenia and cerebral deficits from bilateral frontal lobotomy. Six hours prior to transfer he had swallowed his lower denture, lodging it in his hypopharynx. An attempt to remove the foreign body under iv diazepam sedation was abandoned at a local hospital due to his uncooperative nature and the attendant risk of airway compromise or aspiration pneumonia. History regarding his oral intake was unreliably documented. He also had atherosclerotic heart disease with complete heart block for which a permanent pacemaker was in place.

On examination the patient was alert but demented and uncooperative. He could not talk and was sitting forward, producing copious oropharyngeal secretions. His anxious respiration was interrupted by frequent coughing and intermittent inspiratory stridor. Respiratory rate was 18-20 breaths/min. Cyanosis was absent, as were auscultatory wheezes. Anteroposterior and lateral roentgenograms of the neck (fig. 1) revealed a denture in the hypopharynx. This denture had four molar teeth on either side and was normally attached to his lateral incisors by two pairs of curved sharp hooks. The denture was securely lodged in the hypopharynx with the dental surface anteriorly. A major concern was the contiguous relationship of the denture to the epiglottis and larynx, together with the two pairs of hooks impinging on the lateral hypopharyngeal wall.

Initially the patient was sedated heavily, using incremental doses of iv droperidol to 7.5 mg and thiopental 50 mg. The oropharynx was anesthetized topically with lidocaine 10%. Gentle laryngoscopic examination of the oropharynx revealed the dentures to be wedged securely in place. Further, the vocal cords were obscured completely by the denture. During subsequent discussions, concern was expressed that further forceful manipulation of the airway for either oral endotracheal intubation or removal of the appliance could lead to damage to the pharynx and larynx by the hooks on the denture. Tracheostomy under local anesthesia first was considered to secure the airway. Instead, a trial of transtracheal ventilation with high-frequency manual insufflation was elected, with emergency tracheostomy to be performed if that approach failed.

Transtracheal lidocaine 2%, 2 ml, was administered through the cricothyroid membrane. A 2½ inch 14-gauge percutaneous catheter then was inserted via the cricothyroid membrane. The patient tolerated this well without coughing. Ventilation then was instituted manually through the catheter with a 50 PSI Venturi-Saunders® insufflator at 60 cycles/min and FiO₂ 1.0. Excursion of the chest occurred, and patency of the upper airway was demonstrated. General anesthesia then was induced rapidly and maintained with iv thiopental boluses and succinylcholine by iv infusion. Muscle relaxation was monitored with a peripheral nerve stimulator. Arterial systolic

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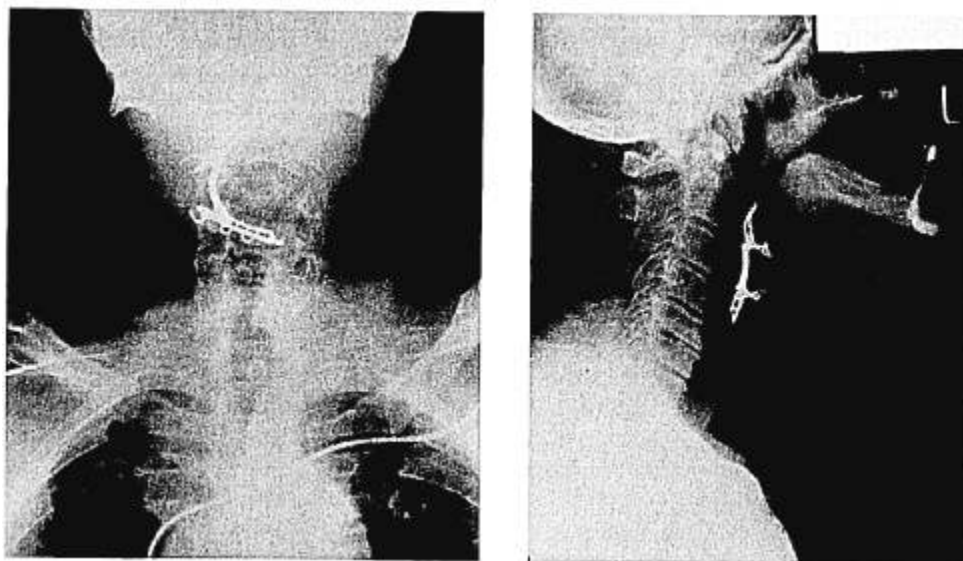
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Received from the Section of Anesthesiology and Otolaryngology, Dartmouth-Hitchcock Medical Center, Hanover, New Hampshire 03755. Accepted for publication November 29, 1984.

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Key words: Airway: foreign body. Ventilation: transtracheal.

FIG. 1. Anteroposterior and lateral roentgenograms of the neck with the dental appliance lodged in the hypopharynx. The denture is composed of four radiolucent molar teeth on each side and two curved sharp hooks that attach to the patient's own lateral incisors. Notably, the teeth in the appliance were radiolucent so that the composite is much larger than it appears radiographically. The left panel demonstrates the impingement of the hooks on the lateral wall. The molar surface faces anteriorly, and the appliance is posterior to the arytenoids in the lateral film (*right panel*). The right-sided teeth are located cephalad to the epiglottis and glottis. A transvenous pacemaker wire is present.



blood pressure remained stable between 130 and 160 mmHg at his paced heart rate of 72 bpm. Fifteen minutes after initiation of ventilation, arterial blood gas values were PAO_2 353 mmHg, PA_{CO_2} 27 mmHg, and pH_a 7.54.

The pharynx and hypopharynx were exposed with a large Davis mouth gag and large tonsil blade. The denture was firmly lodged in the hypopharynx with the dental surface anteriorly. The right sided hooks were embedded in the right lateral wall of the hypopharynx. The left sided hook was located just below the arytenoids on the right side. The lower portion of the denture was the left side, which was wedged in the cervical esophagus posterior to the cricoid cartilage. With a long clamp, the hooks could be dislodged from the hypopharyngeal wall. Nevertheless, substantial force was required to extract the denture from its position in the hypopharynx. Subsequent esophagobronchoscopy revealed puncture holes in the right lateral wall of the hypopharynx without laceration. Transtracheal ventilation was discontinued, after a total of 20 min and the catheter removed. Because substantial bleeding was observed from the transtracheal injection site, the trachea was intubated. A small area of subcutaneous emphysema was apparent in the anterior neck but was localized around the transtracheal entrance site. This resolved prior to extubation. The patient was transferred to the recovery room and the trachea extubated 20 mins later. Hemoptysis continued for the next hour then spontaneously resolved. No further subcutaneous emphysema occurred. A postoperative chest roentgenogram revealed no pneumothorax or mediastinal emphysema. Postoperatively he complained for a day of right lateral neck pain. Prophylactic oral penicillin was given and he was discharged uneventfully on the second postoperative day.

DISCUSSION

The presence of a foreign body in the hypopharynx lying adjacent to the larynx and epiglottis created a difficult airway to manipulate and protect. The dental retaining hooks radiographically appeared imbedded in the pharyngeal wall. This further complicated management, posing the threat of arytenoid or vocal cord trauma and mediastinitis. With a potentially full stomach,

airway protection was deemed necessary to decrease the risk of aspiration pneumonia. Though general anesthesia with paralysis yields ideal surgical conditions for careful airway examination and foreign body removal,⁴ in this case neither tracheal intubation nor a patent airway could be ensured during anesthesia induction. A forceful attempt at awake intubation of the trachea in this uncooperative patient was believed to unacceptably increase the risk and morbidity of laryngeal trauma and the potential for esophageal perforation. Alternatively, spontaneous inhalational induction with halothane or apneic oxygenation with paralysis could be used during foreign body removal.⁵ However, neither approach completely protects against aspiration pneumonia, and the airway cannot be predictably kept patent during induction and maintenance. Nasal or oral intubation over a fiberoptic bronchoscope has been used for upper airway compromise.⁶ This was not attempted in part due to the patient's uncooperative state and copious secretions. Also, it was not certain that an endotracheal tube could be manipulated by the denture. The risk of concomitant laryngospasm was also a mitigating factor.⁷

Jacobs first suggested that high-pressure transtracheal ventilation with consequent rostral gas flow up the trachea aids in the expulsion of secretions and prevents aspiration.³ Klain *et al.* demonstrated bronchoscopically in dogs that transtracheal high-frequency jet ventilation will prevent aspiration of fluid from the mouth with respiratory rates above 60/min and expiratory phase of 30% or greater.⁸ They attributed this to the continuous gas flow acting as pneumatic valve at the level of the cords and a small PEEP effect of high-frequency ventilation. In this case a respiratory rate of 60/min was obtained manually with a Venturi-Saunders® insufflator,

equipment that is readily available in the operating room. Respiratory rate greater than 60 was difficult to maintain manually for prolonged periods due to operator fatigue. However, for this short procedure, transtracheal ventilation with respiratory rate greater than 60/min achieved favorable operating conditions with minimal risk of airway compromise or aspiration pneumonia. Other approaches to airway protection considered in lieu of intubation included either tracheostomy or cricothyroidotomy under local anesthesia but clearly were complicated by this patient's uncooperative state. In contrast, transtracheal ventilation spared the patient another surgical procedure and its subsequent period of wound healing.

The approach used in this patient is certainly not innocuous. The reported complications of transtracheal puncture include hemoptysis, subcutaneous emphysema, mediastinal emphysema, vagal reflexes, hypoxia, and infection.⁹ Holt *et al.* described a patient with massive hemoptysis following transtracheal puncture.¹⁰ This was treated by endotracheal intubation with balloon tamponade of the bleeding site. Though tracheal bleeding was a problem in this patient, hemorrhage was managed successfully by endotracheal tamponade and resolved within 1 h. Subcutaneous emphysema occurred around the puncture site but also resolved rapidly. Both coughing and hemoptysis occurred after extubation of the trachea but without local emphysema. Increased tracheal pressures with coughing potentially could cause air leakage through the tracheal puncture site.

In summary, in this setting percutaneous transtracheal ventilation with high-frequency insufflation for removal

of an irregular upper airway foreign body provided distinct advantages over other techniques. This approach minimized trauma to the airway, risk of aspiration pneumonia, and obviated the need for tracheostomy.

The authors thank Kristin Lanphear for her help in preparing this manuscript.

REFERENCES

1. Smith RB: Transtracheal ventilation during anesthesia. *Anesth Analg* 53:225-228, 1974
2. Heijman K, Heijman L, Jonzon A, Sedin G, Sjostrand U, Widman B: High frequency positive pressure ventilation during anesthesia and routine surgery in man. *Acta Anaesthesiol Scand* 16:176, 1972
3. Jacobs HB: Emergency percutaneous transtracheal catheter and ventilator. *J Trauma* 12:50-55, 1972
4. Burtner DD, Goodman M: Anesthetic and operative management of potential airway obstruction. *Arch Otolaryngol* 104:657-661, 1978
5. Roberts LS, Rayburn R, Matlak ME, Nixon EW: A unique method for the anesthetic management of laryngeal foreign bodies. *ANESTHESIOLOGY* 56:480-482, 1982
6. Ovassapian A, Doka JC, Romsa DE: Acromegaly—use of fiberoptic laryngoscopy to avoid tracheostomy. *ANESTHESIOLOGY* 54:429-430, 1981
7. Fulkerson WJ: Current concepts—fiberoptic bronchoscopy. *N Engl J Med* 311:511-515, 1984
8. Klain M, Keszler H, Stool S: Transtracheal high frequency jet ventilation prevents aspiration. *Crit Care Med* 11:170-172, 1983
9. Spencer CD, Beatty HN: Complications of transtracheal aspiration. *N Engl J Med* 286:304-305, 1972
10. Holt GR, Davis WE, Ailor EJ, Warren AH, Elyassi H: Massive airway hemorrhage after transtracheal aspiration. *South Med J* 71:325-327, 1978