# Chapter 111: Chronic Aspiration

**David W. Eisele**

The three major functions of the larynx - respiration, phonation, and airway production - are all intimately related. Impaired laryngeal protective function can result in aspiration. *Aspiration* is defined as the laryngeal penetration of secretions, such as saliva, ingested liquids or solids, or reflux of gastric contents, below the level of the true vocal cords.

A certain amount of aspiration is known to occur normally. Evaluation of normal humans during sleep by scintigraphy reveals aspiration in nearly one half of those evaluated (Huxley et al, 1978). A certain amount of aspiration may be tolerated without complications provided clearance is normal and defense mechanisms are intact. The contamination of the respiratory tract associated with aspiration can result in a spectrum of bronchopulmonary complications. The severity of complications depends on the volume and the character, such as the pH, of the aspirated material.

Respiratory complications of aspiration include bronchospasm, airway obstruction, tracheitis, bronchitis, pneumonia, pulmonary abscess, sepsis, and death (Awe et al, 1966; Bartlett and Gorbach, 1975; Cameron and Zuidema, 1972). Significant aspiration results in a high rate of mortality (Cameron et al, 1973a).

Aspiration may be an isolated event related to temporary impairment of normal swallowing mechanisms and airway protection, which may secondary to temporary neurologic dysfunction such as with a depressed state of consciousness related to drugs, alcohol, or metabolic derangement. In addition, seizure, injury, or infection may cause isolated aspiration. Elderly patients are more likely to experience aspiration, presumably related to physiologic and neurologic changes associated with age (Blitzer, 1990). Patients with dentures experience impairment of the oral phase of swallowing with decreased oral sensation and oral control, which may contribute to aspiration.

Chronic aspiration or intractable aspiration entails repeated episodes of aspiration. Patients with chronic aspiration require evaluation and effective management to prevent life-threatening complications of aspiration.

The purpose of this chapter is to discuss the evaluation and treatment of patients with chronic aspiration, with an emphasis on surgical management.

## Etiology of Chronic Aspiration

Chronic aspiration usually results from a severe loss of laryngeal protective function related to impaired motor activity and/or sensory loss. Chronic aspiration can occur dspite normal laryngeal function, however, if significant dysfunction of normal swallowing exists. Mechanisms of normal and abnormal swallowing are covered in another chapter.

The box lists causes of chronic aspiration. The most common origin is associated with cerebrovascular accidents, particularly those involving the brainstem with bilateral cranial nerve deficits (Horner et al, 1988). In addition, degenerative neurologic diseases, such as

Parkinson's disease, amyotrophic lateral sclerosis, supranuclear palsy, and multiple sclerosis, are frequently associated with chronic aspiration. Peripheral nerve disorders, particularly those involving the cranial nerves, as well as neuromuscular diseases and muscular disorders can cause recurrent aspiration. Diffuse neurologic dysfunction from head injury, anoxic brain injury, infection, or drug toxicity can cause severe dysfunction and chronic aspiration (Brin and Younger, 1988; Gilbert et al, 1987; Lazarus and Logemann, 1987).

**Box: Chronic aspiration - causes**

Cerebrovascular accidents
- Atherosclerotic thrombosis
- Embolism
- Intracranial hemorrhage

Degenerative neurologic diseases
- Parkinson's disease
- Amyotrophic lateral sclerosis
- Progressive supranuclear palsy
- Multiple sclerosis

Neuromuscular and muscular disorders
- Poliomyelitis
- Myasthenia gravis
- Muscular dystrophy
- Myopathies

Peripheral nerve disorders
- Cranial nerves
- Guillain-Barré syndrome

Intracranial neoplasms
- Primary dysfunction related to neoplasm
- Postsurgical dysfunction

Trauma
- Closed head injury
- Hematoma

Anoxic brain injury

Intracranial infection

Pharyngeal disorders
- Neoplasms
- Postsurgical dysfunction
- Postirradiation dysfunction
- Zenker's diverticulum
- Cricopharyngeal dysfunction
- Stricture

Esophageal disorders
- Reflux
- Achalasia
- Caustic injury

Miscellaneous
- Severe illness
- Multisystem disease

Drug intoxication.

Chronic aspiration can also result from disorders of the pharynx and the esophagus, including neoplasms, postsurgical and postirradiation dysfunction, Zenker's diverticulum, stricture, and severe gastroesophageal reflux (Logemann, 1985).

Chronic aspiration can also occur in pediatric patients, in which case it is usually related to severe neurologic dysfunction resulting from anoxic encephalopathy, other severe congenital or acquired neurologic disorders, sequelae of trauma, and tracheoesophageal fistula.

## Symptoms

Patients may be aware of recurrent aspiration and describe episodes of coughing or choking during the act of swallowing. Some patients, however, may experience silent aspiration, whereby cough does not occur after laryngeal penetration (Horner and Massey, 1988; Linden and Siebens, 1983).

Fever and respiratory symptoms such as productive cough with purulent sputum may occur, indicating an infectious complication.

Patients may have weight loss, dysphonia, pain, dysphagia, odynophagia, or other symptoms, depending on the cause of the underlying disorder (Horner et al, 1988). Frequently, patients are severely ill because of their disease and secondary infectious complications.

## Evaluation

For the evaluation of the patient with chronic aspiration, a detailed medical history is important. Frequently, the cause of aspiration is apparent from the history. The medical history, prior injury, or surgery should be thoroughly investigated.

A multidisciplinary approach to patients with chronic aspiration is important (Martens et al, 1990). Frequently otolaryngology-head and neck surgery consultation is sought by caretakers in other specialties after complications of chronic aspiration have occurred. Once chronic aspiration has been identified, consultations by specialists in speech-language pathology, neurology, internal medicine, rehabilitation medicine, radiology, internal medicine, rehabilitation medicine, radiology, gastroenterology, thoracic surgery, and psychiatry may be beneficial. A cooperative effort in which each specialist provides special expertise ensures optimal care for the patient.

Physical examination should be thorough, with careful examination of the head and neck, including cranial nerve evaluation. Examination of the hypopharynx and larynx is performed by either indirect mirror examination or fiberoptic nasopharyngoscopy. If these structures are not adequately visualized by these methods, for example, for an endotracheally intubated patient, direct laryngoscopy is necessary. Esophagoscopy is performed if an esophageal abnormality is suspected. Pulmonary function tests are helpful for the assessment of pulmonary function and reserve.

Radiographic imaging studies provide important diagnostic information and should include chest radiographs and a barium cinepharyngoesophagogram. Cinepharyngoesophagogram is a dynamic imaging study that reliably provides information about the precise physiologic nature of aspiration and swallowing disturbance as well as about the degree of aspiration (Donner and Silbiger, 1966; Splaingard et al, 1988). A modified barium swallow, as described by Logemann, in which small amounts of barium are used because of the risk of aspiration, is performed (Logemann, 1986). Different consistencies of contrast material are used to assess whether consistency alteration has any effect on aspiration reduction. A cinepharyngoesophagogram performed in conjunction with the speech-language pathologist allows radiographic assessment of the effects of swallowing therapy and maneuvers on control of aspiration.

Other imaging studies that may provide important information include computed tomography (CT) and magnetic resonance imaging (MRI) of the head and neck, and soft tissue radiographs of the neck.

Comprehensive evaluation of the aspirating patient ideally determines the cause of the underlying disorder or disorders causing aspiration. A thorough search for any correctable cause of aspiration, such as an obstructing lesion, Zenker's diverticulum, cricopharyngeal muscle dysfunction, or esophageal motility disorder, is important to treatment.

Frequently, progressive functional deterioration can be anticipated for certain degenerative neurologic diseases and malignant neoplasms. It can be extremely difficult, however, to predict the time course of improvement and recovery for cerebrovascular accidents, head injuries, anoxic brain injuries, postsurgical dysfunction, and other disorders. Multispecialty input is very helpful in planning treatment for these difficult cases.

## Nonsurgical Management

The initial management of the chronically aspirating patient should include treatment of any infectious complications with appropriate antibiotics. Aggressive pulmonary therapy is instituted.

All oral intake is discontinued, and an alternative route of alimentation is provided. Enteral routes of alimentation include small soft nasogastric feeding tubes, cervical esophagotomy, piriform sinusotomy, gastrostomy, and jejunostomy. Gastrostomy can be performed percutaneously easily and with little morbidity. Patients with significant reflux may benefit from a tube passed through a gastrostomy into the small intestine, or jejunostomy.

Depending on the cause of aspiration, nasogastric feeding tube alimentation reduces but does not eliminate the risk of aspiration (Ciocon et al, 1988). Some researchers believe that nasogastric feeding tubes may actually predispose to aspiration (Alessi and Berci, 1986; Elpern et al, 1987). In addition, the tubes can be uncomfortable and aesthetically displeasing for long periods. Gastrostomy alone has been shown not to decrease aspiration in neurologically impaired patients (Hassett et al, 1988). Some patients may be candidates for parenteral hyperalimentation, if gastrointestinal function is impaired, such as individuals who have acute severe brain injury (Norton et al, 1988).

Proper nursing care includes special positioning of the patient, such as elevation of the head of the bed for patients with severe reflux. One study showed no significant difference in aspiration with respect to patient position, however, when the patient was endotracheally intubated (Elpern et al, 1987).

Frequent suctioning of the oral cavity and oropharynx is important.

## Tracheotomy

A tracheotomy tube with a low-pressure cuff is useful for providing comfortable airway control for those requiring intubation and for the facilitation of pulmonary toilet in patients with copious secretions. Tracheotomy also effectively reduces the pulmonary dead space.

Use of a cuffed tracheotomy tube alone, however, is not a reliable method to prevent aspiration (Cameron et al, 1973b; Bone et al, 1974). A tracheotomy tube impairs laryngeal elevation and production of an effective cough (Bonanno, 1971). Prolonged inflation of a tracheotomy cuff results in progressive tracheomalacia (Bryant et al, 1971). In addition, an inflated tracheotomy cuff can transmitt pressure to the cervical esophagus, resulting in a physiologic obstruction (Feldman et al, 1966; Nash, 1988). A tracheotomy tube with an inflated cuff used over an extended period and in the setting of an indwelling nasogastric tube can result in the development of a tracheoesophageal fistula.

Swallowing impairment can also occur with tracheotomy as a result of decreased pharyngeal pressures secondary to a leak through the tracheotomy (Blitzer, 1987). In addition long-term bypass of the upper airway by tracheotomy has been shown to impair reflex laryngeal closure (Sasaki et al, 1977).

The use of a tracheotomy tube for aspiration control requires close attention and skilled care, particularly for the debilitated patient. Several studies have examined the effect of endotracheal and tracheotomy tube cuffs on the prevention of aspiration. Although low-pressure high-compliance cuffs are the most effective in minimizing cuff leak, they do not prevent aspiration (Bernhard et al, 1979; Pavlin et al, 1975; Petring et al, 1986).

## Vocal Cord Paralysis

Particularly when combined with a laryngeal sensory deficit, such as a high vagal lesion, vocal cord paralysis can result in chronic aspiration. The evaluation and treatment of vocal cord paralysis are discussed elsewhere. Vocal cord injection with Teflon or Gelfoam paste can be performed either endoscopically or transcervically to achieve vocal cord medialization and prevent aspiration related to vocal cord paralysis (Lewy, 1964; McCaffrey and Lipton, 1989; Rontal et al, 1976). Absorbable gelatin (Gelfoam) paste is used for temporary vocal cord medialization as it is gradually absorbed (Schramm et al, 1978).

Alteration of the laryngeal framework by medialization laryngoplasty using an implant is another excellent technique for vocal cord medialization (Isshiki et al, 1975; Kaufman, 1986). This procedure is reversible since the implant can be removed easily if vocal cord function returns.

No consistently successful results of the use of bilateral vocal cord injection or bilateral medialization laryngoplasty for chronic aspiration have been reported.

## Surgery for Chronic Aspiration

Sometimes a correctable cause of chronic aspiration is not identified, and the nonsurgical and minor surgical procedures described, such as tracheotomy and vocal cord medialization, are not successful in preventing chronic aspiration. In these cases surgical separation of the upper digestive tract from the upper respiratory tract is necessary to prevent the morbidity and mortality of recurrent respiratory tract soilage. A reasonable probability of survival and duration of survival are necessary prerequisites for this surgery.

Clinical judgement must be relied on to determine the likelihood of recovery of laryngeal protective function and to identify those patients who require prompt surgical intervention to separate the upper digestive and respiratory tracts in order to prevent death. The patient's general medical and mental status, severity of illness, and potential quality of life must be addressed (Blitzer, 1990).

The patient may have to sacrifice normal phonation and laryngeal respiration to ensure restoration of airway protection. This is a difficult issue that requires thorough discussions of treatment options and sequelae with the patient and family members.

## "Ideal" surgical procedure for chronic aspiration

The ideal surgical procedure for chronic aspiration would be uniformly effective in preventing aspiration, be simply achieved, and have few complications and low morbidity. Ideally, the procedure could be performed with local anesthesia for debilitated patients. In addition, the ideal procedure would allow phonation and deglutition and be reversible should the underlying cause of aspiration improve.

## Laryngectomy

Before 1970, laryngectomy was considered the surgical treatment of choice for chronic aspiration. This procedure provides definitive separation of the upper digestive and respiratory tracts. A narrow-field laryngectomy (Fig. 111-1) is used, in contrast to the total laryngectomy performed for malignancy. This procedures preserves the hyoid, strap muscles, and as much hypopharyngeal mucosa as possible. Closure without tension with reinforcement minimizes the potential postoperative complications of pharyngeal stenosis and fistula (Briant, 1975).

Laryngectomy has been recommended as the surgical treatment of choice for chronic aspiration because of the low likelihood of recovery of most patients with this problem (Cannon and McLean, 1982; Hawthorne et al, 1987).

Narrow-field laryngectomy can be performed with local anesthesia. Tracheoesophageal puncture and placement of a voice prosthesis can be used for vocal rehabilitation after laryngectomy if residual neuromuscular function permits coordinated acts of swallowing and phonation in appropriate patients.

Because of the disadvantage of irreversibility of laryngectomy and the observation that some patients with chronic aspiration recover, other surgical procedures have been developed since the 1970s for the surgical treatment of chronic aspiration.

## Subperichondrial cricoidectomy

Another option for definitive surgical separation of the upper respiratory and digestive tracts, when no chance of recovery of function is expected, is the subperichondrial cricoidectomy developed by Cummings (1990) (Fig. 111-2). In this technique, the anterior aspect of the cricoid cartilage is exposed. The perichondrium of the anterior cricoid cartilage is divided vertically in the midline to expose the cricoid, which is divided in the midline vertically. The inner and outer perichondria of the cricoid are then dissected away from the cricoid cartilage circumferentially with an elevator, and the cricoid cartilage is then removed. The inner perichondrium and subglottic mucosa are transected horizontally, inverted, and closed, creating a subglottic pouch. The outer perichondrium is then closed. The sternohyoid muscle is separated from its hyoid insertions and rotated into the space created by the subglottic mucosal division. This provides an additional layer of protection, reducing the potential for fistulization. A tracheotomy is necessary.

Advantages of this technique include a high success rate, simplicity, low morbidity, and maintenance of laryngeal prominence. This procedure can be performed easily under local anesthesia. Disadvantages include the remote possibility of fistula into the upper trachea and the need for a tracheotomy. The procedure was not designed to be reversible, although reversal might be possible with laryngotracheal anastomosis.

## Partial cricoidectomy

Krespi et al (1985) described subtotal and submucosal cricoid resection for the control of chronic aspiration after extensive surgical resection of pharyngeal and base of tongue tumors, particularly those undergoing myocutaneous flap reconstruction. The posterior cricoid perichondrium is elevated, and the posterior half of the cricoid lamina is removed without entering the mucosa. A cricopharyngeal myotomy is also performed. A tracheotomy is necessary. Partial cricoidectomy enlarges the pharyngeal inlet, facilitating deglutition, and to narrow the laryngeal inlet, reducing aspiration and preserving the voice.

Biller and Urken (1985) described partial cricoid collapse for the prevention of aspiration after extended horizontal partial laryngectomy. Vertical segments of the hemicricoid are removed. The hemicricoid is then collapsed with stabilization of the cricoid segments to a midline position, narrowing the laryngeal opening and correcting glottic incompetence.

## Endolaryngeal stents

Several types of endolaryngeal stents have been used to prevent chronic aspiration. Weisberger and Huebsch (1982) reported the use of a solid silicone (Silastic) laryngeal stent, which was placed endoscopically and secured transcervically with sutures (Fig. 111-3). A tracheotomy tube is necessary. Aspiration was prevented and oral intake tolerated in three of seven patients with chronic aspiration. Perioperative mortality was high in this series and was thought to be related to tracheotomy tube obstruction. The endoscopic reversal of the stent

procedure was reported in two patients; however, both required stent replacement for aspiration control.

Eliachar and co-workers have reported two types of vented silicone laryngeal stents for control of aspiration (Fig. 111-4) (Eliachar et al, 1987; Eliachar and Nguyen, 1990). The newer of the two stents is inserted through a tracheotomy and is secured by means of a flexible strap of silicone extending from the tracheotomy tract above the tracheotomy tube. Eliachar and Nguyen reported aspiration control in 11 of 12 patients with chronic aspiration with the newer stent. For one patient, for whom the initial procedure failed, placement of a larger size stent achieved aspiration control. The stent had been used for up to 9 months in their report. Of the 3 patients who survived and had successful stent removal, 1 experienced laryngeal granulation tissue requiring laser excision and in another an anterior subglottic web developed.

Laryngeal stents are easily introduced and, if properly sized for the patient, are successul in preventing aspiration (Eliachar and Nguyen, 1990). Laryngeal stents, however, have the disadvantages of lack of uniform success caused by leakage around the stent and/or extrusion. Because of the potential for endolaryngeal injury from the stent or tracheotomy tube displacement with airway occlusion by the stent, short-term use is recommended.

Other disadvantages of stents include patient discomfort and the need for the special stent in different sizes. Endolaryngeal stents have to this point failed to gain wide acceptance for chronic aspiration control; however, they may achieve wider application with modifications.

## Epiglottic flap closure of larynx

An epiglottic flap technique of glottic closure was described by Habal and Murray (1972). With this technique, the supraglottic larynx is approached via an infrahyoid pharyngotomy. The supraglottic larynx is closed after denuding the edges of the epiglottis, aryepiglottic folds, and arytenoids and then suturing the epiglottis as a flap posteriorly to the aryepiglottic folds and arytenoids (Fig. 111-5). A tracheotomy is required.

Since that initial report, several modifications and refinements of this procedure have been described. Strome and Fried (1983) described diminishing the tensile strength and elasticity of the epiglottic cartilage by either morsalization, linear striations, or wedge excision, as well as severing of the hyoepiglottic and thyroepiglottic ligaments. These modifications were added to the technique to lessen the complication of dehiscence of the flap posteriorly (Habal and Murray, 1972; Vecchione et al, 1975; Weisberger and Huebsch, 1982). A fortuitous result of this frequent complication is allowance of speech in some patients.

A further modification of the epiglottic flap closure procedure purposefully leaves the posterior laryngeal inlet open to allow phonation (Brooks and McKelvie, 1983; Vecchione et al, 19750. Another modification of this procedure suspends the larynx to the mandible to provide additional laryngeal protection (Warwick-Brown et al, 1986). Denuding the false vocal cords of mucosa and approximating the false vocal cords provide an additional layer of closure for laryngeal inlet obliteration (Cummings et al, 1984).

Success of the epiglottic flap closure of the larynx for prevention of chronic aspiration occurs in only approximately 50% of the procedures reported, although failures can be successfully revised (Laurian et al, 1986).

This procedure is reversible, and successful endoscopic reversal has been reported (Strom and Fried, 1983). Reports of reversal of the epiglottic flap closure procedure, however, are uncommon.

Advantages of the epiglottic flap closure include reversibility, allowance of deglutition, and speech preservation if the posterior laryngeal inlet is left open or if dehiscence of the closure occurs. In addition, the true vocal cords are not injured by this procedure.

Disadvantages of the epiglottic flap closure procedure include a high rate of flap dehiscence and failure and the need for a transcervical approach and tracheotomy. Supraglottic stenosis is a potential complication following reversal (Vecchione et al, 1975).

## Vertical laryngoplasty

The vertical laryngoplasty was described by Biller et al (1983) for the prevention of aspiration in patients who required total glossectomy for advanced carcinoma of the tongue (Fig. 111-6). In this technique, an incision is made along the outer borders of the epiglottis and carried inferiorly and posteriorly along the aryepiglottic folds over the arytenoids and into the interarytenoid area. The epiglottis and supraglottic larynx are then closed vertically in two layers as a tube, leaving a small opening superiorly. This technique has also been applied to patients with chronic aspiration with satisfactory results, allowing deglutition and speech (Blitzer, 1987).

## Glottic closure

The glottic closure procedure was described by Montgomery (1975). In this procedure (Fig. 111-7), the larynx is closed at the level of the true and false vocal cords. A midline thyrotomy is performed initially, exposing the endolarynx. The true and false vocal cords, ventricles, and posterior commissure are denuded of mucosa. Nonabsorbable monofilament sutures are then used to approximate the glottic surfaces to provide glottic closure. In addition, absorbable sutures are used to approximate the flase vocal cords margins. A tracheotomy tube is necessary.

The glottic closure procedure was modified by Sasaki et al by the addition of a sternohyoid muscle flap to provide an additional layer of laryngeal closure (Kirchner and Sasaki, 1984; Sasaki et al, 1980).

The reported results of the glottic closure procedure for the prevention of aspiration are excellent, with an approximate 95% success rate. There has been only one report of successful reversal of the glottic closure procedure (Lulenski, 1980).

Advantages of the glottic closure procedure include high success rate for prevention of aspiration, allowance of deglutition, and potential reversibility. Glottic stenosis, however, makes reversal difficult.

Disadvantages of the glottic closure procedure include the need for a transcervical approach and thyrotomy, loss of phonation, need for a tracheotomy, and endolaryngeal injury involving the true vocal cords. Performing the procedure is technically challenging; the interarytenoid closure is the most difficult step. A preexisting laryngeal abnormality is a contraindication for this procedure.

### Tracheoesophageal diversion and laryngotracheal separation

The tracheoesophageal diversion procedure was described by Lindeman (1975). This procedure for chronic aspiration was devised with the objective of developing a reliable surgical technique that would provide control of aspiration for an indefinite period, while preserving the larynx and the integrity of the recurrent laryngeal nerves. The procedure was designed to be reversible, should normal laryngeal protective function return.

The tracheoesophageal diversion procedure (Fig. 111-8) is performed by division of the trachea horizontally approximately at the level of the fourth and fifth tracheal rings. The proximal tracheal segment is then anastomosed in an end-to-side fashion to an opening in the anterior esophagus. The distal tracheal segment is drawn out to the anterior cervical skin as a tracheostoma.

In 1976, a similar surgical procedure for chronic aspiration, the laryngotracheal separation procedure, was described (Lindeman et al, 1976). The laryngotracheal separation procedure was designed for those patients with chronic aspiration who had previously undergone high tracheotomy, which prevents establishment of a tracheoesophageal anastomosis, as is performed in the tracheoesophageal diversion procedure.

The laryngotracheal separation procedure (Fig. 111-9) is performed by division of the trachea horizontally between the second and third tracheal rings or at the level of an existing tracheotomy. The proximal tracheal edges are then closed onto themselves anteroposteriorly as a blind pouch. The tracheal closure is buttressed with rotated sternothyroid muscles. The distal tracheal segment is drawn out as a tracheostoma.

A modification of the tracheoesophageal diversion procedure (Fig. 111-10) has been described; an anterior tracheal flap is created by removal of the inferior half of the cricoid cartilage and the anterior aspects of the first and second tracheal flaps (Krespi et al, 1984). This modification creates a soft flap, which allows the use of the tracheoesophageal diversion procedure in patients who have undergone prior tracheotomy.

Tucker (1979) proposed division of the trachea and externalization of the proximal trachea between the fibers of the sternocleidomastoid muscle to the cervical skin. It was theorized that sternocleidomastoid muscle compression would collapse the trachea, thus limiting external leakage of secretions. This procedure effects definitive separation of the respiratory tract and the digestive tract and prevents aspiration. Tracheal secretions draining onto the neck, however, may be aesthetically displeasing and require local care.

Many authors have reported uniform success in chronic aspiration control with the tracheoesophageal diversion procedure and the laryngotracheal separation procedure (Baron and Dedo, 1980; Eisele et al, 1989; Gilbert et al, 1987; Snyderman and Johnson, 1988).

Postoperatively, in both procedures, most patients are able to tolerate a normal diet, depending on their neurologic function. In some instances, reversals of both procedures and resultant normal voice, swallowing, and respiration have been reported (Eisele et al, 1989; Snyderman and Johnson, 1988). Both procedures can be performed with local anesthesia if necessary.

The tracheoesophageal diversion procedure has been recommended for those patients with chronic aspiration who have not had high tracheotomy (Eisele et al, 1988). The tracheoesophageal diversion procedure allows secretions and oral intake that has penetrated the larynx to pass into the esophagus. On the other hand, the laryngotracheal separation procedure is technically the easier of the two to perform. These techniques have proved equally effective in controlling chronic aspiration.

Complications after these procedures are uncommon; they include postoperative fistula, which usually closes spontaneously with local care and antibiotics.

Patients are considered to be candidates for reversal of either the tracheoesophageal diversion procedure or the laryngotracheal separation procedure on the basis of evidence of neurologic improvement and the results of laryngoscopy and cinepharyngoesophagography. Reversals have been performed most commonly in patients who have recovered from cerebrovascular accidents or in those who have had resection of bening intracranial tumors (Eisele et al, 1989).

Advantages of the tracheoesophageal diversion procedure and the laryngotracheal separation procedure are that they are the most dependable of the reversible techniques for preventing chronic aspiration. These procedures allow oral alimentation and are reversible, since the endolarynx is avoided and the larynx is not injured.

The disadvantages of these procedures include the need for a transcervical approach and the loss of capacity for air-powered speech. Most patients, depending on their neurologic function, communicate with an electrolarynx after these procedures.

The tracheoesophageal diversion procedure and the laryngotracheal separation procedure have also been successfully performed with satisfactory results in children who had chronic aspiration (Cohen and Tompson, 1987; Eavey, 1985).

## Summary

Chronic or intractable aspiration is a serious problem, usually related to severe neurologic dysfunction. Chronic aspiration requires a thorough evaluation and treatment of any correctable causes. Surgical separation of the upper respiratory tract and upper digestive tract may be necessary to prevent repeated soilage of the respiratory system with recurrent infectious complications and death.

If there is no chance of recovery of neurologic function, surgical options for chronic aspiration control include narrow-field laryngectomy and subperichondrial cricoidectomy. If recovery is possible, laryngotracheal separation and tracheoesophageal diversion are effective and reversible surgical techniques to prevent chronic aspiration.