

# Swallowing Dysfunction after Tracheostomy

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OCCASIONALLY the presence of a tracheostomy tube will have an adverse effect upon swallowing. Previous reports of such an effect conclude that this was the result of esophageal compression either by a distended trachea or interference with the normal physiology of deglutition.<sup>10, 23</sup>

The exact neuromuscular mechanism by which the criopharyngeus muscle relaxes and permits deglutition to take place is unknown.<sup>3, 13, 15, 18, 20, 21, 24, 25</sup> Numerous studies have been performed via pressure and cinegraphic technics to elucidate the intrinsic pharyngeal neuromuscular pathways responsible for the accomplishment of the second stage of swallowing.<sup>1, 2, 3, 5, 12, 13, 27</sup> These studies lead to the generally accepted conclusion that an intact neural arc to relax the hypopharyngeal sphincter and functioning pharyngeal constrictors are of prime importance in normal swallowing. Some investigators allude to the upward and anterior movement of the larynx as a biproduct of these functions but do not consider it to be a prime factor.<sup>1, 2, 17</sup> Edgerton<sup>9</sup> brought to light the effect of the hyomandibular complex on swallowing and its importance in establishing a correct anatomic relationship between the oral cavity, pharynx and larynx. This relationship is altered following major resections of the mandible and submental region with resultant difficulties in swallowing and aspiration pneumonia. Shedd<sup>26</sup> further showed that this is by

no means an absolute relationship and with subtotal losses of the hyomandibular complex patients may learn to accommodate to altered anatomy. The effects of the anterior muscles of the neck on swallowing have generally gone unnoted but for Ramsey's<sup>21</sup> brief remark that he believes that these muscles are capable of laryngeal elevation and rotation. If the hyomandibular complex effectively elevates and anteriorly rotates the larynx and thereby passively stretches the criopharyngeus, it may be postulated that inhibition of this mechanism would have a deleterious affect on swallowing. Clinically it has been noted by Kremen<sup>14</sup> that on occasion a patient who is experiencing difficulty swallowing will have this difficulty alleviated upon removal of the tracheostomy tube. Feldman and Robbie<sup>10, 23</sup> suggested that regurgitation into the larynx may result from compression of the cervical esophagus by an over distended trachea or the tracheostomy tube. The above mentioned observation led to a prospective study performed on patients who require tracheotomy as a part of postoperative management. The swallowing mechanism was evaluated with cinepharyngograms to ascertain whether there were any observable defects in the physiology of deglutition.

## Materials and Methods

Forty-three patients who were to undergo elective or semi-elective tracheostomies were chosen for this study (Table 1).

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TABLE 1. *Type of Operative Procedure and Distribution of Dysphagia Cases*

Operation	No. Patients	Dysphagia Patients
Gastrectomy	15	A
Pulmonary resection	12	B
Vascular (abdominal)	10	C
Hiatus hernia repair	3	
Drainage subphrenic abscess	1	
Thoracic esophagectomy	1	
Pericardectomy	1	

TABLE 2. *Laryngeal Elevation in Cm.*

No. Pts.	Pre.	Intra.	Postoperative
41	>3	>3	>3
3	>3	1.5-2	3

These patients were deemed poor pulmonary risks because of emphysema, marked obesity or decreased pulmonary reserve secondary to pulmonary fibrosis. Objective measurements such as spirometry, blood gas analysis and chest x-rays were used to evaluate all patients.

Elective tracheostomy was performed in the operating room under general anesthesia with the endotracheal tube in posi-

tion. The tracheostomy was performed through a vertical skin incision and was of the fenestration type with the second and third anterior tracheal rings being excised.<sup>4, 19, 28</sup> The trachea was intubated with a cuffed standard tube, and the skin was loosely approximated.<sup>8</sup>

Radiologic determinations were made by taking anterior-posterior and lateral cinepharyngograms,<sup>3, 24</sup> preoperatively on the tenth postoperative day and on the day of extubation. In patients who developed dysphagia, multiple x-ray studies were performed until extubation was accomplished. When dysphagia developed, direct laryngoscopy, under topical anesthesia, was performed to evaluate the motor and sensory integrity of the pharyngo-larynx.

### Results

Dysphagia associated with a tracheostomy developed in three of the 43 prospectively studied patients.

Radiographic examination of laryngeal excursion showed a definite abnormality in all three patients (Table 2). The initial or voluntary stage of swallowing was easily initiated in all patients. Dysphagia devel-

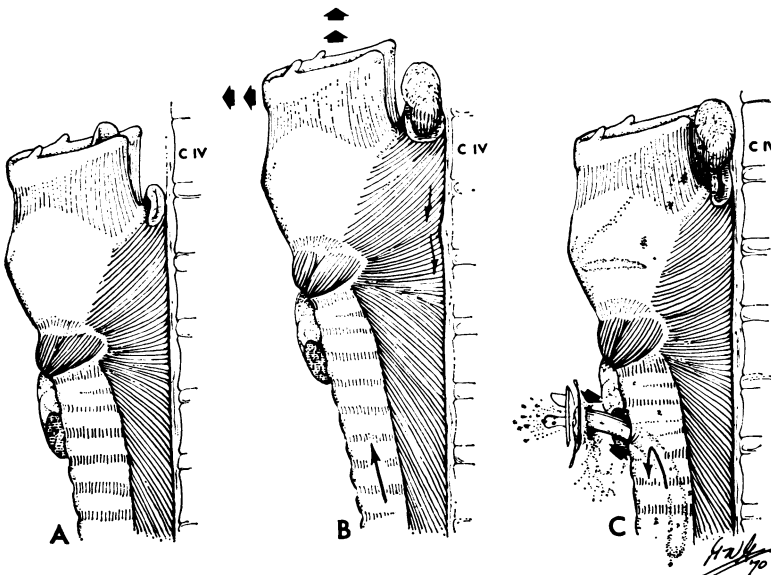


FIG. 1. A. Normal pharyngo-larynx at rest. B. Pharyngo-larynx during normal deglutition. C. Tracheostomy tube inhibiting elevation and anterior rotation of the larynx with failure of the hypopharyngeal sphincter to completely open.

### The Tracheostome

Examination of the tracheostome showed peristomal inflammation in all instances which progressed to local purulent infection in 11 patients.<sup>4, 28</sup> The organisms in the stomal infections were similar to organisms found in cultures taken from the patients' bronchial aspirates. These wounds healed by secondary intention and by the

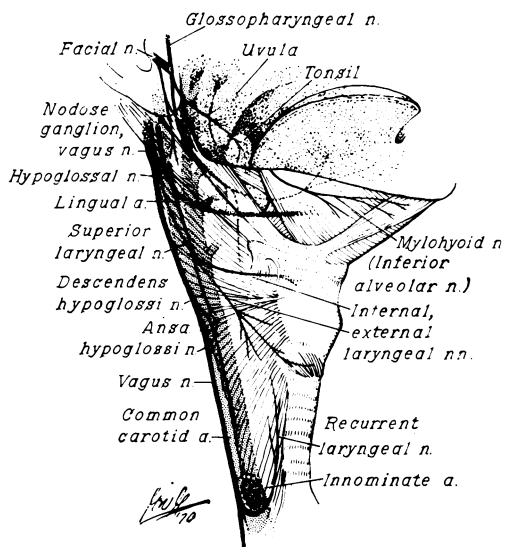


FIG. 2. Distribution of motor and sensory nerves necessary for normal swallowing.

oped with inhibition of the second or involuntary stage.<sup>18</sup> The first part of the second stage, elevation of the soft palate, medial mobilization of the palato-pharyngeal folds, posterior inclination of the epiglottis and approximation of the vocal cords was normal when compared to pre-operative controls. Limitation of the latter part of the second stage was marked by a diminution of the elevation and anterior rotation of the larynx. This resulted in failure of the hypopharyngeal sphincter to relax with resultant spillage of the contrast meal into the larynx and in tracheal aspiration (Fig. 1).

Sensory and motor function of the pharynx and larynx was evaluated by direct laryngoscopy. Mucosal stimulation demonstrated that the maxillary, glossopharyngeal and internal laryngeal nerves were intact (Fig. 2). The vocal cords moved in a normal fashion and the cricothyroideus functioned well (recurrent and external laryngeal nerves) in all instances of dysphagia.



FIG. 3. Cineradiogram showing stagnated bolus above the pharyngeal sphincter and spillage into the larynx.

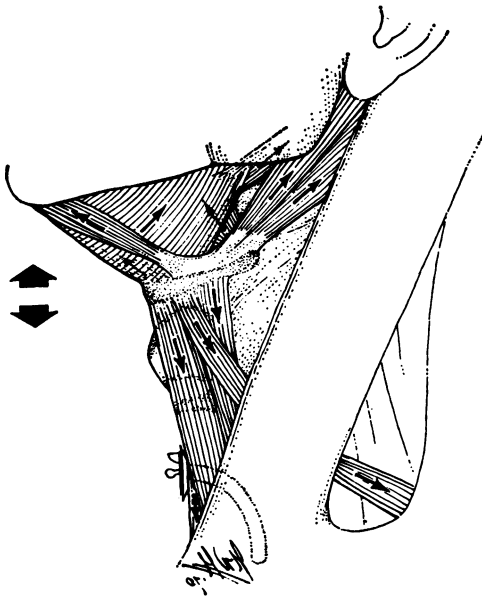


FIG. 4. Scheme of the interaction of the hyomandibular muscle complex and the anterior muscles of the neck.

tenth day the tracheostome was surrounded by granulation tissue. The three instances of dysphagia belong to this group.

The three patients who showed abnormal roentgenographic findings (Fig. 3) and were experiencing dysphagia with aspiration pneumonia and were fed via nasogastric intubation until all evidence of pneumonia had cleared which was on the 30th, 34th, and 78th days (patients A, B and C, respectively) at which time they were extubated and fed a liquid diet. Minimal aspiration occurred initially and patients A and B could promptly swallow without difficulty. The cinepharyngogram showing the return of normal laryngeal excursion, patient C, however, continued to aspirate and still had radiographic evidence of laryngeal restriction which lasted 3 weeks and then returned to normal.

Radiographic measurements of tracheal width revealed no posttracheostomy dilatation. In all cases, the postoperative di-

mensions compared favorably with the preoperative controls.

In no case did the barium meal go beyond the hypopharyngeal sphincter and then regurgitate into the trachea.

### Discussion

Tracheotomy is usually performed on poor respiratory risk patients or on patients where the operative procedure directly jeopardizes the patient's airway. This safeguards the patient from asphyxia, but the safeguards may, in certain cases, provoke aspiration of saliva or food. This has been observed clinically<sup>6, 14</sup> with some surgeons advocating removal of the tube and others insisting that it be retained until swallowing is accomplished.

In certain instances it appears as though the tube itself (Fig. 4) is anchoring the trachea to the strap muscles and the skin<sup>4</sup> of the neck. This resulted in limitation of elevation and anterior rotation of the larynx and interferes with relaxation of the hypopharyngeal sphincter.

The loss of the hypomandibular muscle group function has been considered as the main reason for swallowing difficulties after extirpative head and neck operations.<sup>9, 11, 22</sup> The adverse effects of the cuffed tracheostomy tube upon deglutition have been reported.<sup>10, 23</sup> The marked inflammatory reaction and tracheal destruction by the tracheostomy tube has been extensively studied,<sup>7, 16</sup> and an increased incidence of swallowing difficulties has been observed when the tracheostomy is of long duration.<sup>4</sup>

### Summary

This prospective study attempts to demonstrate that in some patients following tracheostomy, difficulty in swallowing results not from compression of the esophagus by the tube or a distended trachea but by direct inhibition of the hyomandibular

complex. This occurs as a result of the tracheostomy tube anchoring the trachea to the strap muscles and skin of the neck along a tract of cicatrix. The usual function of the suprahyoid musculature is thereby checkreined and the laryngeal excursion is diminished. The possible neural inhibition of the suprahyoid and pharyngeal musculature was investigated and found not to be a factor.

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